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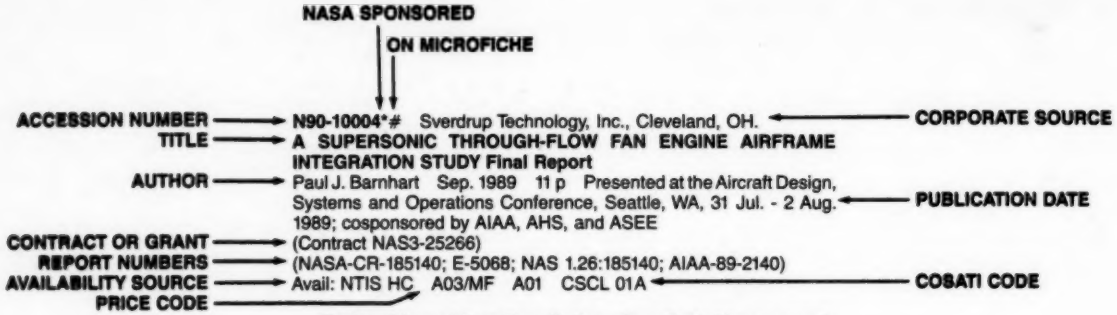
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ACCESSION NUMBER
N90-10004*# Sverdrup Technology, Inc., Cleveland, OH.
CORPORATE SOURCE
TITLE
A SUPERSONIC THROUGH-FLOW FAN ENGINE AIRFRAME INTEGRATION STUDY Final Report
AUTHOR
Paul J. Barnhart Sep. 1989 11 p Presented at the Aircraft Design, Systems and Operations Conference, Seattle, WA, 31 Jul. - 2 Aug. 1989; cosponsored by AIAA, AHS, and ASEE
PUBLICATION DATE
CONTRACT OR GRANT
(Contract NAS3-25266)
REPORT NUMBERS
(NASA-CR-185140; E-5068; NAS 1.26:185140; AIAA-89-2140)
AVAILABILITY SOURCE
Avail: NTIS HC A03/MF A01 CSCL 01A
COSATI CODE
PRICE CODE

Engine airframe integration effects are investigated for superonsic through-flow fan engines installed on a Mach 3.20 supersonic cruise vehicle. Six different supersonic through-flow fan engine installations covering the effects of engine size, nacelle contour, nacelle placement, and approximate bypass plume effects are presented. The different supersonic through-flow fan installations are compared with a conventional turbine bypass engine configuration on the same basic airframe. The supersonic through-flow fan engine integrations are shown to be comparable to the turbine bypass engine configuration on the basis of installed nacelle wave drag. The supersonic through-flow fan engine airframe integrated vehicles have superior aerodynamic performance on the basis of maximum lift-to-drag ratio than the turbine bypass engine installation over the entire operating Mach number range from 1.10 to 3.20. When approximate bypass plume modeling is included, the supersonic through-flow fan engine configuration shows even larger improvements over the turbine bypass engine configuration. Author

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01 AERONAUTICS (GENERAL)

N90-16707# RAND Corp., Santa Monica, CA.
THE USE OF PROTOTYPES IN SELECTED FOREIGN FIGHTER AIRCRAFT DEVELOPMENT PROGRAMS: RAFALE, EAP, LAVI, AND GRIPEN Interim Report
Mark A. Lorell and Donna Kim Hoffman Sep. 1989 79 p
(Contract MDA903-85-C-0030)
(AD-A214500; RAND/R-3687-P/L; ISBN-0-8330-0970-2) Avail: NTIS HC A05/MF A01 CSCL 01/3

This report surveys and compares the approaches to prototyping adopted by four countries--Great Britain, France, Israel, and Sweden--during the development of similar new fighter/attack aircraft. It is based primarily on information gathered during interviews and briefings conducted in 1987 with senior government and industry officials of those countries. Basic fighter airframe risks and uncertainties to warrant the manufacture and flight testing of an austere airframe prototype before full-scale development (FSD). However, avionics development and integration are becoming areas of increasingly high technological complexity, uncertainty, and risk. Effective development and adequate testing and integration may be possible only with the help of sophisticated avionics ground labs and with fully missionized prototypes that are essentially pre-production FSD engineering test articles. A combination of both pre-FSD austere prototyping and missionized prototyping may be required to meet the challenges arising in the acquisition environment of the late 1980s. GRA

N90-16708# Southwest Research Inst., San Antonio, TX.
INSPECTION DEVELOPMENT FOR T-37 WING SPAR CAP LUG Final Report, 1 Oct. 1988 - 30 Jun. 1989
Jay L. Fisher, Gary L. Burkhardt, Stephen N. Rowland, Jr., John H. Fitzgerald, and Robert J. Dexter Jun. 1989 58 p
(Contract DLA900-84-C-0910)
(AD-A214826; SRI-17-7958-851; SAALC/MMEP-88-02) Avail: NTIS HC A04/MF A01 CSCL 14/2

The purpose of this project was to develop an eddy current nondestructive inspection technique and procedure for the fatigue-critical location on the lower cap lug fillet of the T-37 wing spar, and to develop and conduct an inspection reliability program to quantify the inspection capability. The inspection capability goal was to demonstrate a probability of detection of 90 percent with a 95 percent confidence level for 0.050 inch radius fatigue cracks in the critical region of the lug. A hand-operated mechanical probe manipulator was developed to ensure uniform inspection results. A set of test specimens with fatigue cracks was fabricated for the reliability study. All of the goals were met or exceeded in the program. GRA

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N90-16709 Illinois Univ., Urbana-Champaign.
AN IMPROVEMENT OF CONVECTION FIDELITY IN EULER CALCULATIONS Ph.D. Thesis
Shiaw Shinn Chu 1988 95 p
Avail: Univ. Microfilms Order No. DA8908655

A new solution procedure was developed to solve the Euler equations for steady, compressible, rotational, inviscid flows. The approach is aimed at achieving real inviscid solutions in Euler calculations by eliminating the numerical diffusion inherent in conventional approaches. In conventional approaches which solve for the time-dependent conservation equations, the numerical diffusion is either built-in through finite truncations or added externally for reasons of numerical stability. The resulting solutions are, therefore, not solutions to the Euler equations but to the pseudo Navier-Stokes equations with numerical viscosity instead of physical viscosity. That is, convective quantities in resulting Euler solutions are contaminated by numerical diffusion and false entropy production. This numerical diffusion is also responsible for the solution dependency on the grids used and the solution reliability of the Navier-Stokes solutions with physical viscosity terms. The present approach is based on splitting the character of the Euler equations into elliptic and convective quantities by using the Clebsch velocity decomposition. In the approach, the continuity equation is solved by a finite volume algorithm in the conservative form and then convective quantities are transported along streamlines without numerical diffusion. An efficient upwind difference scheme is developed to solve the convection equation for streamlines. Dissert. Abstr.

N90-16710*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
NASA SUPERCRITICAL AIRFOILS: A MATRIX OF FAMILY-RELATED AIRFOILS
Charles D. Harris Washington Mar. 1990 73 p
(NASA-TP-2969; L-16625; NAS 1.60:2969) Avail: NTIS HC A04/MF A01 CSCL 01A

The NASA supercritical airfoil development program is summarized in a chronological fashion. Some of the airfoil design guidelines are discussed, and coordinates of a matrix of family related supercritical airfoils ranging from thicknesses of 2 to 18 percent and over a design lift coefficient range from 0 to 1.0 are presented. Author

N90-16711 Catholic Univ. of America, Washington, DC.
AN EXPERIMENTAL INVESTIGATION OF VISCOUS ASPECTS OF PROPELLER BLADE FLOW Ph.D. Thesis
Stuart Dodge Jessup 1989 260 p
Avail: Univ. Microfilms Order No. DA8912977

An experimental investigation of the laminar/turbulent flow in the vicinity of a rotating propeller blade was conducted using laser Doppler velocimetry. Details of the flow were measured to assess the viscous features relative to classical potential theory.

Three-dimensional velocity component measurements were made of the propeller blade boundary layer and wake using laser Doppler velocimetry with a phase averaging technique to account for blade rotation. The propeller blade flow was characterized by streamwise and radial boundary layer profiles. Laminar boundary layers were initiated at the leading edge with transition to turbulence occurring at the mid-chord of the blade. The midspan streamwise boundary layer resembled typical two-dimensional behavior. The radial boundary layer exhibited large outward flow near the wall in regions of laminar flow which was reduced after transition. The outer blade boundary layer edge velocities along the blade were predicted by potential theory implying no significant viscous-invicid interactions. Dissert. Abstr.

N90-16712*# Stanford Univ., CA. Dept. of Aeronautics and Astronautics.

CONTROLLED VORTICAL FLOW ON DELTA WINGS THROUGH UNSTEADY LEADING EDGE BLOWING

K. T. Lee and Leonard Roberts Jan. 1990 144 p
(Contract NCC2-55)
(NASA-CR-186267; NAS 1.26:186267; SU-JIAA-TR-97) Avail: NTIS HC A07/MF A01 CSCL 01A

The vortical flow over a delta wing contributes an important part of the lift - the so called nonlinear lift. Controlling this vortical flow with its favorable influence would enhance aircraft maneuverability at high angle of attack. Several previous studies have shown that control of the vortical flow field is possible through the use of blowing jets. The present experimental research studies vortical flow control by applying a new blowing scheme to the rounded leading edge of a delta wing; this blowing scheme is called Tangential Leading Edge Blowing (TLEB). Vortical flow response both to steady blowing and to unsteady blowing is investigated. It is found that TLEB can redevelop stable, strong vortices even in the post-stall angle of attack regime. Analysis of the steady data shows that the effect of leading edge blowing can be interpreted as an effective change in angle of attack. The examination of the fundamental time scales for vortical flow re-organization after the application of blowing for different initial states of the flow field is studied. Different time scales for flow re-organization are shown to depend upon the effective angle of attack. A faster response time can be achieved at angles of attack beyond stall by a suitable choice of the initial blowing momentum strength. Consequently, TLEB shows the potential of controlling the vortical flow over a wide range of angles of attack; i.e., in both for pre-stall and post-stall conditions. Author

N90-16713# National Aerospace Lab., Tokyo (Japan).

PROCEEDINGS OF THE 6TH NAL SYMPOSIUM ON AIRCRAFT COMPUTATIONAL AERODYNAMICS

Dec. 1988 252 p In JAPANESE; ENGLISH summary Symposium held in Tokyo, Japan, 16-17 Jun. 1988
(DE89-910195; NAL-SP-9) Avail: NTIS (US Sales Only) HC A12/MF A02

These proceedings collect the 37 theses presented at the 6th NAL Symposium on Aircraft Computational Aerodynamics. The main theses, among others, comprise 9 theses of simulation of supersonic turbulent flow action about winged body, 7 theses of numerical analysis to obtain more accurate solution of Navier-Stokes equation, 4 theses of study of combustion in gas turbine and jet engine, 4 theses of numerical analysis of flow around transonic aircraft, 4 theses of study of hypersonic viscous flow around space plane and 4 theses of aerodynamical calculation of space plane, which are result reports of use of TV, TVD and ATVD2 schemes as calculation methods for the transition from the transonic zone to the supersonic zone. Apart from those theses, the visualization of computed unsteady flow in three dimensions and prototypical production to develop a new supercomputer utilizing the parallel computer, among others, were reported. DOE

N90-16714# Naval Postgraduate School, Monterey, CA. Dept. of Aeronautics and Astronautics.

FLOWFIELD EFFECTS OF LAUNCH ON A VERTICALLY-LAUNCHED MISSILE M.S. Thesis

John J. Viniotis Jun. 1989 160 p
(AD-A214468) Avail: NTIS HC A08/MF A01 CSCL 16/4

The flowfield about a vertically launched surface-to-air missile model at an angle of attack of 50 deg and a Reynolds number of 110,000 was investigated in a low speed wind tunnel at the NPG School. The location and intensity of the asymmetric vortices in the wake of the VLSAM model is determined and these vortices are displayed by velocity mapping and pressure contours. The two model configurations tested were for a cruciform missile with wings and tails; one at 0 deg roll angle (plus aspect) and the other at a 45 deg roll angle (cross aspect). Two flowfield conditions were treated: the nominal ambient wind tunnel condition and a condition with a grid-generated turbulence of length scale 1.08 inches and 1.88 percent turbulence intensity. The turbulence length scale is 61.7 percent of model diameter and 4.7 percent of model length. Conclusions include: (1) an increase in turbulence intensity tended to reduce the strength of the asymmetric nose generated vortices; (2) the two asymmetric vortices remained in approximately the same position for an increase in turbulence; (3) cross aspect vortices were more diffused, slightly larger and centered further away from the model surface than those of the plus aspect body configuration, which correlates with the differences in induced side forces for these configurations observed by Rabang; (4) the top vortex of the two asymmetric vortices was closer to the model surface and appeared to be stronger for both configurations; and (5) addition of wings and tails did not greatly alter the vortex pattern around the nose of the missile model. GRA

N90-16715# Princeton Univ., NJ. Dept. of Mechanical and Aerospace Engineering.

DEVELOPMENT AND APPLICATION OF OXYGEN FLOW TAGGING FOR VELOCITY MEASUREMENTS AND FLOW VISUALIZATION IN TURBULENT THREE-DIMENSIONAL SUPERSONIC FLOWS Final Technical Report, 1 Jun. 1986 - 31 May 1989

Richard B. Miles 30 Aug. 1989 16 p Sponsored in part by Lockheed-California Co.
(Grant AF-AFOSR-0191-86; AF Proj. 2307)
(AD-A214491; AFOSR-89-1323TR) Avail: NTIS HC A02/MF A01 CSCL 20/4

Flow tagging by Raman Excitation plus Laser Induced Electronic Fluorescence (RELIEF) and ultraviolet Rayleigh scattering were developed to measure instantaneous velocity profiles, temperatures, and density cross sections in air. Experiments were undertaken in supersonic free jets and supersonic boundary layers. In these experiments lines were written into air to give the first direct images of velocity structure in supersonic free shear layers, and UV Rayleigh scattering was used to achieve the first measurements of instantaneous 2-D density cross sections in free jets and in supersonic boundary layers. GRA

N90-16716# Princeton Univ., NJ. Dept. of Mechanical and Aerospace Engineering.

PHYSICAL MODELS FOR SUPERSONIC TURBULENT BOUNDARY LAYER STRUCTURE Final Report, 15 Feb. 1988 - 14 Jun. 1989

Alexander J. Smits 17 Oct. 1989 32 p
(Grant AF-AFOSR-0120-88; AF Proj. 2307)
(AD-A215284; AFOSR-89-1580TR) Avail: NTIS HC A03/MF A01 CSCL 20/4

An experimental program was carried out to study the detailed structure of supersonic turbulent boundary layers. The experiments were designed to elucidate physical models and mechanisms that are particular to compressible turbulence, such as the effects of compressibility on the nature of the large-scale motions, the scaling laws for high Reynolds number supersonic turbulent flows, direct compressibility effects that cause the exchange of turbulence energy among the vorticity, entropy and sound modes, and the

transport of heat and momentum by compressible turbulent motions. A description of the new optical experimental tools that were developed is included. GRA

N90-16717# Centre d'Etudes Aerodynamiques et Thermiques, Poitiers (France).
DEVELOPMENT OF FLOW VISUALIZATION AND NONINTRUSIVE VELOCITY MEASUREMENT IN TURBULENT FLOW Final Report [DEVELOPPEMENT DE TECHNIQUES DE VISUALISATION ET DE MESURE NON INTRUSIVE DE VITESSE EN ECOULEMENT TURBULENT]
J. P. Bonnet and R. E. Falco (Michigan State Univ., East Lansing.) May 1989 27 p Partly in ENGLISH and FRENCH
(Contract DRET-DS/SSR-88/1441)
(ETN-90-96077) Avail: NTIS HC A03/MF A01

Experimental measurement campaigns are reported. Conventional visualization is used to characterize the separation of a boundary layer in the presence of an external turbulent flow. A second campaign is devoted to the development of a measurement method based on the use of tracers with photochemical properties. The experiments were done in wind tunnel under turbulent supersonic conditions. It is shown that the main advantage of the method is the simultaneous measurement of velocities in many points. ESA

N90-16718# Institut Franco-Allemand de Recherches, Saint-Louis (France).
MEASUREMENT OF THE AERODYNAMICAL COEFFICIENTS RELATED TO SQUARE SECTION MODELS DEFINED BY RESEMBLANCE TO THE NORMALIZED MODELS AGARD HB1 AND HB2 IN SUPERSONIC FLOW. PART 2: INCIDENCE UP TO 25 DEG [MESURE DES COEFFICIENTS AERODYNAMIQUES RELATIFS A DES MODELES DE SECTION CARREE DEFINIS PAR SIMILITUDE AVEC LES MODELES NORMALISES AGARD-HB1 ET HB2 EN ECOULEMENT SUPERSONIQUE. 2EME PARTIE: EXTENSIONJ USQU'A UNE INCIDENCE DE 25 DEG]
B. Gautier, A. Koeneke, and J. P. Duperoux 13 Apr. 1988 54 p In FRENCH
(ISL-R-108/88-Pt-2; ETN-90-96099) Avail: NTIS HC A04/MF A01

The experimental analysis, now extended to 25 deg incidence is applicable to the new nonconventional missile cross sections. The goal is to verify if this change in geometry does not handicap excessively the aerodynamic performance. The performance is then compared to equivalent circular cross section shape. An important modification of aerodynamic coefficients is observed, which is translated into an increase of the lift to drag ratio. ESA

N90-16719*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
VISCOUS EFFECTS ON THE INSTABILITY OF AN AXISYMMETRIC JET
K. B. M. Q. Zaman and J. M. Seiner (National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.) Feb. 1990 28 p
(NASA-TM-102396; E-4152-1; NAS 1.15:102396) Avail: NTIS HC A03/MF A01 CSCL 01A

The stability characteristics of a laminar, axisymmetric jet, issuing from fully developed Poiseuille flow, are investigated. The jet preferred frequency, as inferred from surveys of u'-spectra, is found to yield a Strouhal number (St) that depends on the Reynolds number (R); St and R are based on the jet diameter (D) and the average velocity (U sub av) at the jet origin. The value of St increases with increasing R in the range 400 less than approximately R less than approximately 4000, attaining an asymptotic value of about 0.45. Flow visualization confirms that the instability is primarily in a helical mode, as predicted by stability analyses. Analyses do predict a similar St versus R variation in approximately the correct St-range. However, the R-range where this is predicted is lower than that found experimentally. Author

N90-16720 ESDU International Ltd., London (England).
IN-PLANE FORCES AND MOMENTS ON INSTALLED INCLINED PROPELLERS AT LOW FORWARD SPEEDS Abstract Only
Dec. 1989 22 p
(ESDU-89047; ISBN-0-85679-721-9; ISSN-0141-397X) Avail: ESDU

ESDU 89047 gives simple semi-empirical methods for estimating the forces and moments on single or contra-rotating propellers inclined at angles up to 20 degrees with the local flow. The results are given graphically as derivatives with respect to the local flow angle, and that must be separately evaluated if forces and moments are required. The graphical data are plotted as functions of thrust coefficient (from 0 to maximum likely) and advance ratio from 0 to 3, for a range of values of solidity from 0.05 to 0.5. The data apply strictly to six-bladed propellers, but the results are found to be insensitive to the number of blades between 2 and 10. For cases where the solidity is unknown an approximate relationship is given to derive values from the total activity factor. Comparisons with test data extracted from the literature suggest the force derivatives are predicted to within 15 percent and moments to within 40 percent, but it is felt those are conservative assessments due to the test difficulties of measuring the small forces and moments. A detailed worked example illustrates the use of the data. ESDU

N90-16721 ESDU International Ltd., London (England).
ESTIMATION OF SUBSONIC FAR-FIELD JET-MIXING NOISE FROM SINGLE-STREAM CIRCULAR NOZZLES Abstract Only
Dec. 1989 26 p Supersedes ESDU-74002
(ESDU-89041; ISBN-0-85679-714-6; ISSN-0307-0115; ESDU-74002) Avail: ESDU

ESDU 89041 gives a graphical method for estimating overall and one-third octave band sound pressure levels as a function of observer distance and angle to the efflux plane, jet pipe diameter, and jet temperature and velocity. The method is derived by correlating experimental data from model tests in which all sources of noise other than that due to pure jet mixing have been eliminated. Atmospheric absorption and ground reflection effects are excluded. ESDU 85018 complements the method by providing a means for interpolating in or extrapolating any jet noise experimental data: it includes a database, which is that used here, and the user can replace or supplement that database as appropriate. ESDU

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N90-16722# Sandia National Labs., Albuquerque, NM. Aerospace Projects Div.
RISK ASSESSMENT AND ITS APPLICATION TO FLIGHT SAFETY ANALYSIS
David L. Keese and William R. Barton Dec. 1989 17 p
(Contract DE-AC04-76DP-00789)
(DE90-004985; SAND-89-1982) Avail: NTIS HC A03/MF A01

Potentially hazardous test activities were historically a part of Sandia National Labs mission to design, develop, and test new weapons systems. These test activities include high speed air drops for parachute development, sled tests for component and system level studies, multiple stage rocket experiments, and artillery firings of various projectiles. Due to the nature of Sandia's test programs, the risk associated with these activities can never be totally eliminated. However, a consistent set of policies should be available to provide guidance into the level of risk that is acceptable in these areas. A general set of guidelines is presented for addressing safety issues related to rocket flight operations at Sandia National Laboratories. Even though the majority of this report deals primarily with rocket flight safety, these same principles

could be applied to other hazardous test activities. The basic concepts of risk analysis have a wide range of applications into many of Sandia's current operations. DOE

N90-16723# Army Aviation Engineering Flight Activity, Edwards AFB, CA.
NATURAL ICING RE-EVALUATION OF THE EH-60A QUICK FIX HELICOPTER Final Report, 25 Feb. - 13 May 1989
David A. Downey, Andrew J. Tailby, and Joseph L. Piotrowski May 1989 65 p
(AD-A214728; USAAEFA-88-06-1) Avail: NTIS HC A04/MF A01 CSCL 01/3

Natural icing flight tests were conducted on the EH-60A helicopter (USA S/N 86-24569) Quick Fix system to establish an icing flight envelope with the AN/ALQ-151(V)2 countermeasures system installed. Eight flights with a total of 11.1 productive test hours were flown in a natural icing environment at Duluth, MN between 25 February and 13 March 1989. Two deficiencies were noted: the design of the electronic countermeasures (ECM) antenna assembly and mount which caused excessive ice-induced oscillations and subsequent component failure and the poor reliability of the integrated inertial navigation system (IINS). Two icing-related shortcomings were noted: the loosening of the direction finding (DF) dipole antennas during flight in icing conditions and the inaccuracy of the liquid water content (LWC) readings of the Rosemount icing rate meter. The poor integration of the IINS and flight instruments which prevented the direct display of TACAN information was also a shortcoming. One previously identified icing-related deficiency and seven previously identified icing-related shortcomings of the UH-60A/EH-60A helicopter were re-evaluated and remain uncorrected. The EH-60A Quick Fix helicopter, with modified DF antenna insulator housing (part no. 1951-1-4116-4), should be released for flight in moderate icing conditions with the ECM antenna retracted only. GRA

N90-16724# Dayton Univ., OH. Research Inst.
THE COLLECTION OF NON-CONUS AIRCRAFT ICING DATA ALONG WITH AN IDENTIFICATION OF THE GEOGRAPHICAL AREAS OF POTENTIAL SEVERE ICING AND A STUDY OF A METHOD OF REMOTE DETERMINING ATMOSPHERIC ICING DATA
Nicholas A. Engler, Patrick A. Haines, and Clifford A. Cerbus Jan. 1988 120 p
(Contract DTFA03-85-C-00009)
(AD-A215055; UDR-TR-88-10) Avail: NTIS HC A06/MF A01 CSCL 01/3

Research was conducted in three areas. Surveys were made of foreign countries and whenever possible aircraft icing data was retrieved that would be suitable for inclusion into the already established FAA/NRL icing data base. Those geographical areas were determined where icing would be a problem for aircraft. And an alternate data collection scheme was developed which could be used in lieu of flying aircraft to obtain icing data. Realistic methods are discussed for identifying potentially severe icing geographical regions of the Northern Hemisphere. A useful method to calculate the liquid water content of a remote region is described. The collection of nonconus aircraft is shown and data is presented. Author

N90-16725# Aeronautical Research Labs., Melbourne (Australia).
RAAF ORION AIRCRAFT A9-300 OXYGEN FIRE
S. A. Barter and L. W. Hillen 1987 46 p Original contains color illustrations
(AD-A215496; ARL-APP-R-84; DODA-AR-004-535) Avail: NTIS HC A03/MF A01 CSCL 01/3

This report summarizes the findings of the investigation into the nature and cause of the fire in RAAF Orion aircraft A9-300. This aircraft was destroyed by a fire which initiated in the oxygen system as the result of an explosion caused by metal ignition. GRA

N90-16726# Centre d'Essais Aeronautique Toulouse (France).
ANALYSIS OF INDIRECT EFFECTS OF LIGHTNING ON A METALLIC A 300 WING: TEST REPORT [ANALYSE DES EFFETS INDIRECTS DE LA FOUDRE SUR UNE VOITURE METALLIQUE A 300. PROCES-VERBAL E87/645800]
28 Feb. 1989 25 p In FRENCH
(Rept-E87/645800; ETN-90-96078) Avail: NTIS HC A03/MF A01

Lightning simulation tests using currents from 2 to 45 kA are described. The two pseudo axial current returns installed are detailed. Time profiles of the typical simulated lightning parameters are given. An extrapolation method is suggested in order to simplify the aircrafts qualification tests for metallic structures. ESA

N90-16727# Centre d'Essais Aeronautique Toulouse (France). Lab. Essais d'Impacts sur Structures.
BIRD IMPACT TESTS ON ASYMMETRIC SANDWICH STRUCTURES MADE IN KEVLAR 49 Partial Test Report No. 5 [ESSAIS D'IMPACTS A L'OISEAU SUR STRUCTURES SANDWICH DISSYMETRIQUES EN KEVLAR 49]
17 Aug. 1988 61 p In FRENCH Sponsored by Service Technique des Programmes Aeronautiques, Paris, France
(CEAT-NT-10/S/83-5; Rept-S3-4273-5; ETN-90-96079) Avail: NTIS HC A04/MF A01

Angular impacts on flat panels were studied. Several methods to avoid the perforation of the panel were tried. It is found that painting does reduce the bird friction enough to avoid perforation. Improvements are found either by including metallic plates above the panel surface or by modifying the ply composition and orientation. ESA

N90-16728# Centre d'Essais Aeronautique Toulouse (France).
BIRD IMPACT TESTS ON CURVED STRUCTURES OF THE TYPE SANDWICH-KEVLAR-NIDA FOR NORMAL AND ANGULAR SHOOTING Partial Test Report No. 4 [ESSAIS D'IMPACTS A L'OISEAU SUR STRUCTURES COURBES DE TYPE SANDWICH-KEVLAR-NIDA. TIRS NORMAUX ET OBLIQUES]
M. Etcheto 14 Nov. 1985 72 p In FRENCH Sponsored by Service Technique des Programmes Aeronautiques, Paris, France
(CEAT-NT-10/S/83-4; Rept-S3-4274-4; ETN-90-96080) Avail: NTIS HC A04/MF A01

Normal or angular impacts on curved panels were studied in complement to similar studies made for flat panels. The resistance for the same number of plys is lower than that of flat plates. For small curvature radius, the resistance is equivalent to that of flat panels. The shape of the perforation is a cross or a star. ESA

N90-16729# Lawrence Livermore National Lab., CA. Dept. of Chemistry and Materials Science.
ANALYSIS OF DAMAGED COMPONENTS FROM DOE SECURITY HELICOPTER N7EG
Charles E. Witherell 6 Nov. 1989 23 p
(Contract W-7405-eng-48)
(DE90-004488; UCID-21898) Avail: NTIS HC A03/MF A01

Initial contact with Lawrence Livermore National Laboratory (LLNL) was made on October 16, 1989 through a telephone call by EG and G Energy Measurements organization in Las Vegas, Nevada. This subsequently led to shipment to Livermore of the damaged searchlight components, together with several photographs showing views of the damaged searchlight and its attachment locations on the helicopter. Photographs of an intact and undamaged searchlight assembly in various positions mounted on an operating helicopter were also supplied. The damaged parts were shipped on October 19th with a covering letter dated October 18th. The shipment included two major sub-assemblies: the searchlight body, and its supporting yoke. Accompanying these were several fractured screw-heads and two fractured steel tubes. The objectives of the LLNL investigation, as stated in the covering letter, were to conduct an: analysis of the broken brackets, screws, and other apparatus, and to assist in establishing a failure mode of the assembly. DOE

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *Communications and Radar.*

N90-16730# Computer Technology Associates, Inc., Colorado Springs, CO.

FAA AIR TRAFFIC CONTROL OPERATIONS CONCEPTS. VOLUME 7: ATCT (AIRPORT TRAFFIC CONTROL TOWERS) TOWER CONTROLLERS Final Report

J. R. Alexander, V. L. Alley, H. L. Ammerman, W. S. Fairhurst, and C. M. Hostetler 21 Apr. 1989 790 p

(Contract DTFA01-85-Y-010304)

(AD-A210455; DOT/FAA/AP-87/01-Vol-7) Avail: NTIS HC A99/MF E06 CSCL 01/5

Operations concepts for the Air Traffic Controllers are presented. How Tower controllers in Airport Traffic Control Towers may perform their operational jobs in the manual, ARTS, TPX-42 environment is described. Separate analysis are presented for the three basic control positions: Local Control, Ground Control, and Clearance Delivery/Flight Data. Included are: Composition Graphs, showing the logical flow of operational tasks performed in response to or anticipation of external Air Traffic Events; a series of analyses of these tasks, including information Requirements, Cognitive/Sensory Attributes, and Performance criteria; a User Interface Language aggregating system input and output messages in a hierarchical organization; decomposition of tasks to their constituent procedural elements; and traceability between tasks and ATC procedures documents. Data presented are generated and maintained using the Computer-Human Operational Requirements Analysis System (CHORAS). CHORAS includes an automated task data base, specialized graphing capabilities, and display and hard copy output features tailored to the needs of operations concept analysis. GRA

N90-16731# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Guidance and Control Panel.

ADVANCES IN TECHNIQUES AND TECHNOLOGIES FOR AIR VEHICLE NAVIGATION AND GUIDANCE

Dec. 1989 200 p In ENGLISH and FRENCH Symposium held in Lisbon, Portugal, 9-12 May 1989

(AGARD-CP-455; ISBN-92-835-0535-2) Copyright Avail: NTIS HC A09/MF A02; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The following topics are addressed: terrain reference navigation methods; positioning by image processing or Global Positioning System; mission and sensor management; new techniques and algorithms; sensor technology; and systems applications. For individual titles, see N90-16732 through N90-16747.

N90-16732# British Aerospace Public Ltd. Co., Bracknell (England).

RECENT DEVELOPMENTS IN TERPROM

Denis M. Grey and Robert S. Dale *In* AGARD, Advances in Techniques and Technologies for Air Vehicle Navigation and Guidance Dec. 1989 15 p (For primary document see N90-16731 09-04)

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Terrain Reference Navigation Systems (TRANs) began developemt some 30 years ago but since then their appeal has broadened considerably. The British Aerospace (BAe) Terrain Matching Profile system (TERPROM) is one of the most mature. It has three basic modes of operation and a number of features which navigation is but one. Terrain Following (TF) and intelligent ground proximity warning are just two of several benefits which result from TERPROM's ability to interpret the digital map data base. These features were all tested in a variety of fast-jet aircraft. Recent developments include TERPROM's integration with other systems such as Doppler, Scene Matching Area Correlation (SMAC), and Global Positioning System (GPS) to improve navigation performance even further and moreover, a redesign of the system architecture was proposed which enables the best information from a range of sensors to be used both for navigation and weapon aiming. Author

N90-16733# Technische Univ., Clausthal-Zellerfeld (Germany, F.R.). Inst. fuer Elektr. Informationstechnik.

POSITION FIXING BY DETECTION OF ROADS AND RIVERS

E. Muehlenfeld *In* AGARD, Advances in Techniques and Technologies for Air Vehicle Navigation and Guidance Dec. 1989 8 p (For primary document see N90-16731 09-04)

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An image sensor, looking straight downward from an aircraft, detects line-shaped patterns of roads, rivers, or railroads with a detection rate of 75 percent. Combining these measurement with stored map data on these traffic routes and with INS data yields reliable position estimates within + or - 8 meters. Author

N90-16734# Hochschule der Bundeswehr, Munich (Germany, F.R.). Dept. of Aerospace Technology.

AUTONOMOUS AUTOMATIC LANDING THROUGH COMPUTER VISION

R. Schell and E. D. Dickmanns *In* AGARD, Advances in Techniques and Technologies for Air Vehicle Navigation and Guidance Dec. 1989 9 p (For primary document see N90-16731 09-04)

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The automatic autonomous landing approach through computer vision was investigated in a simulation loop with real image sequence processing hardware and software. The use of integral spatio-temporal world models is the presupposition to achieve real time performance with the microprocessors currently available. Results achieved for a business-jet aircraft demonstrate that this set up is powerful enough to solve the problem of autonomous unmanned landing approach. Author

N90-16735# Technische Univ., Brunswick (Germany, F.R.). Inst. of Guidance and Control.

INTEGRATED FLIGHT GUIDANCE SYSTEM USING DIFFERENTIAL-GPS FOR LANDING APPROACH GUIDANCE

Thomas Jacob and G. Schaenzer *In* AGARD, Advances in Techniques and Technologies for Air Vehicle Navigation and Guidance Dec. 1989 10 p (For primary document see N90-16731 09-04)

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Using the satellite based Global Positioning System (GPS) for precision flight guidance, accuracy problems arise due to the influence of dynamic maneuvers on GPS receivers. The error behavior in stationary as well as in dynamic applications is explained. From the error behavior a system concept of an Integrated Flight Guidance System is derived. Different concepts of system integration are explained. The results of a closed loop mechanization of a Kalman filter coupling GPS and INS implemented in the Integrated Flight Guidance System were checked by simulation and flight test results in approach and landings up to CAT 2. Author

N90-16736# Defense Advanced Research Projects Agency, Arlington, VA.

MINIATURE GPS-BASED GUIDANCE PACKAGE

L. Stotts, J. Aein, and N. Doherty (Mitre Corp., Bedford, MA.) *In* AGARD, Advances in Techniques and Technologies for Air Vehicle

Navigation and Guidance Dec. 1989 18 p (For primary document see N90-16731 09-04)
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The technical goals, issues, and status of the Global Positioning System (GPS) based Guidance Package (GGP) effort within the Aerospace and Strategic Technology Office of DARPA are presented. The GGP exploits the synergisms achieved by combining inertially sensed (IMU) movement with externally sensed GPS reference signals. The goal is to produce a combined GPS/IMU navigation grade system which will be miniaturized for easy insertion to any host vehicle and inexpensive for use by expendable vehicles (weapons and platforms). Efforts already under way within the DoD community based on integrating conventional navigation technologies result in systems on the order of 65 lbs, 160 watts, 1800 cu. in., and $15 K per unit. The GGP builds upon the integrated circuit technology from the preexisting DARPA mini GPS receiver (MGR) program combined with the following: solid state linear accelerometers and fiber optic rotation rate sensors (gyros) for three axes inertial sensing, and a data processor and associated software to implement a Kalman filter to integrate the sensor outputs and provide the navigation solution as well as any filtered velocity, acceleration, and orientation data needed by the host vehicle. Major cost reduction breakthroughs are offered by FOG sensors which employ integrated optic chips for light wave processing along with the polarization preserving fiber optic rotation sensing coil and laser diode optical source. GGP host vehicle insertion is also facilitated by its packing/customizing achieved through modularity of MGR, IMU, and navigation microprocessor subsystems. Modularity is achieved with standardization of the Kalman filter architecture in the navigation processor and data transfer points (ports) interfacing the MGR and IMU sensors to the navigation processor. Technical detail is provided on the following topics: functional architecture, technology, and status of the MGR chip set: desired performance, approach, status, and technology issues for a FOG sensor, and system level integration and performance issues. Author

N90-16737# Centre d'Enseignement et de Recherches de Medecine Aeronautique, Paris (France). Dept. d'Ergonomie Aerospatiale.

ADVANCES IN NAVIGATION SUPPORT SYSTEMS BASED ON OPERATIONAL PILOT'S HEURISTICS

F. Deblon, A. Guengant (Dassault-Breguet Aviation, Saint Cloud, France), C. Valot, and R. Amalberti *In* AGARD, Advances in Techniques and Technologies for Air Vehicle Navigation and Guidance Dec. 1989 12 p In FRENCH; ENGLISH summary (For primary document see N90-16731 09-04)
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The conjecture of the future battlefield (many threats, single seat combat aircraft) will impose the development of onboard decision support systems. The concept of pilot's assistant fits this need in assistance. While this concept covers different classes of aids, the focus is on the development of a navigation support system. Special attention was paid to the quality of man-machine coupling of such a real-time aid. It is evidenced that, because the quality of the coupling is a vital goal, the best solution consists in computerizing the navigation expertise with the greatest proximity of human being (and not with optimal multi-expert and/or multi-constraint software). Thus, pilot expertise elicitation was closely conducted during 4 years in nap of the earth penetration mission. A AI computer model of navigation is derived from this cognitive model with respect to the use of actors language. Extended description of this program is given in the paper, including direct connections with the future of the French's pilot assistant. Author

N90-16738*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

NASA/RAE COOPERATION ON A KNOWLEDE BASED FLIGHT STATUS MONITOR

G. F. Butler (Royal Aircraft Establishment, Farnborough, England) and E. L. Duke *In* AGARD, Advances in Techniques and Technologies for Air Vehicle Navigation and Guidance Dec. 1989 9 p (For primary document see N90-16731 09-04)
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As part of a US/UK cooperative aeronautical research pragram, a joint activity between the Dryden Flight Research Facility of the NASA Ames Research Center (Ames-Dryden) and the Royal Aerospace Establishment (RAE) on Knowledge Based Systems was established. Under the agreement, a Flight Status Monitor Knowledge base developed at Ames-Dryden was implemented using the real-time IKBS toolkit, MUSE, which was developed in the UK under RAE sponsorship. The Flight Status Monitor is designed to provide on-line aid to the flight test engineer in the interpretation of system health and status by storing expert knowledge of system behavior in an easily accessible form. The background to the cooperation is described and the details of the Flight Status Monitor, the MUSE implementation are presented. Author

N90-16739# Societe d'Applications Generales d'Electricite et de Mecanique, Paris (France). Missile and Space Guidance Systems Unit.

EXPERT SYSTEM FOR KALMAN FILTER SUPERVISION: APPLICATION TO AUTONOMOUS SATELLITE NAVIGATION

Dominique Berton, T. Codron, R. Horak, and S. Saile (Grenoble-1 Univ., Saint Martin d'Heres, France) *In* AGARD, Advances in Techniques and Technologies for Air Vehicle Navigation and Guidance Dec. 1989 12 p (For primary document see N90-16731 09-04)
(Contract DRET-87-464)
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The realization of a rule based supervisor which ensures the good performance and the robust behavior of a non-liner Kalman filter is presented. Together with the description of the functional architecture of this supervisor, the different sources of knowledge are explained and how they are used to program the rule. The typical characteristics of the Real Time Expert System which is the heart of the supervisor is analyzed, and also how the emission of actions in real time led to selection of an original tool to generate the Expert System. Rules and results are presented, they are applied in the case of a navigation filter for satellites and show considerable improvements in performances of the Kalman filter once coupled with the Expert System. Author

N90-16740# Air Force Wright Research and Development Center, Wright-Patterson AFB, OH.

APPLICATION OF MULTIFUNCTION INERTIAL REFERENCE SYSTEMS TO FIGHTER AIRCRAFT

John M. Perdzock, Jack Jankovitz, and Carlos A. Bedoya (McDonnell Aircraft Co., Saint Louis, MO.) *In* AGARD, Advances in Techniques and Technologies for Air Vehicle Navigation and Guidance Dec. 1989 19 p (For primary document see N90-16731 09-04)
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Advanced high performance fighter and transport aircraft depend on reliable, accurate, inertially derived data to perform such subsystem functions as fly-by-wire automatic flight control, fire control, weapon delivery, navigation, guidance, and cockpit displays. These data are currently obtained from inertial reference sensors which are essentially dedicated for each major functional application. Future inertial reference systems must meet the requirements of the functional users and have lower life cycle

cost, increased survivability to combat damage, and improve reliability and accuracy. One way to meet these requirements is to use the same sensors to provide kinematic data to all applications. The feasibility of such a system was investigated in the Multifunction Inertial Reference Assembly (MIRA) study. The MIRA is defined by combined inertial requirements for flight control, cockpit display, weapon delivery, and navigation resulting in a common reference package for multiple users. A history of development activity is shown. Author

N90-16741# Societe d'Applications Generales d'Electricite et de Mecanique, Paris (France). Div. Missiles/Espace.
INTELLIGENT LANDMARKS RECOGNITION IN SATELLITES IMAGES
Olivier Reichert and Dominique Berton *In* AGARD, Advances in Techniques and Technologies for Air Vehicle Navigation and Guidance Dec. 1989 13 p In FRENCH; ENGLISH summary (For primary document see N90-16731 09-04)
(Contract DRET-97-464)
Copyright Avail: NTIS HC A09/MF A02; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The determination of the position of a known landmark within a ground image allows, among other things, an update on on-board satellite navigation filter. In the application described, the landmark recognition process uses image correlation techniques and is supervised by a real-time expert system. The system controls a library of algorithms by dynamically selecting the most appropriate algorithms considering the features of the landmark, the likely perturbations in the search area and the time constraints, then by interpreting the results through a multicriteria analysis. Several processings are successively triggered and the fusion of their results provide a better confidence on the final update decision. The performances on SPOT multispectral images show the superiority of this approach with respect to more classical recognition techniques, especially in terms of robustness and autonomy. Author

N90-16742# Naval Weapons Center, China Lake, CA.
REUSABLE NAVIGATION MODULE
C. W. Hall and K. A. Kohout *In* AGARD, Advances in Techniques and Technologies for Air Vehicle Navigation and Guidance Dec. 1989 4 p (For primary document see N90-16731 09-04)
Copyright Avail: NTIS HC A09/MF A02; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The principal objective of the reusable software task is to determine if missile software that is mission specific can be made reusable, and if so, how best to identify and create the reusable parts. A baseline was established from an Independent Exploratory Development (IED) project. The baseline consisted of many packages, procedures, subprograms, and functions, but rather than attempt to make the entire package reusable, attention was focused on the navigation portion. From this navigation portion evolved the common metaparts into a reusable navigation module that could be used either intact or modified in other missile systems. This reuseable navigation module was implemented in the MIL-STD-1815A (Ada) language, mandated by Directives 3405.1 and 3405.2 for computers integral to weapon systems. Methodologies were explored for identifying, developing, and verifying a reusable navigation module. Currently, several navigational metaparts, were identified and developed. The remainder of the project will be devoted to porting the software to a multiprocessor system, upon which it will be further tested and evaluated for reusability on another typical missile application. Author

N90-16743# University Coll. of North Wales, Bangor.
PARALLEL PROCESSING IMPLEMENTATION OF A FLIGHT CONTROLLER
P. J. Fleming, F. Garcia Nocetti, C. M. Jones, H. A. Thompson, G. Ingle, and E. Balley (Royal Aircraft Establishment, Farnborough, England) *In* AGARD, Advances in Techniques and Technologies for Air Vehicle Navigation and Guidance Dec. 1989 11 p (For primary document see N90-16731 09-04)
Copyright Avail: NTIS HC A09/MF A02; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The feasibility of using a parallel processing transputer-based network, programmed in occam, for the implementation of an aircraft flight control law is investigated. Three techniques to generate the concurrent realization of this control law are described and illustrated together with some indications of their strengths and weaknesses. Software tools were used and developed to automate the mapping of the control law on the transputer system. Integration of the existing control hardware on-board the aircraft and the parrallel processing hardware was also addressed. Author

N90-16744# Societe de Fabrication d'Instruments de Mesure, Massy (France). Recherches et Developpements/Navigation-Guidage.
LOW AIR SPEED COMPUTATION FOR HELICOPTERS: A NEW APPROACH [ANNEMOMETRIE BASSE VITESSE: UNE NOUVELLE APPROCHE]
Yves Paturel *In* AGARD, Advances in Techniques and Technologies for Air Vehicle Navigation and Guidance Dec. 1989 19 p In FRENCH (For primary document see N90-16731 09-04)
Copyright Avail: NTIS HC A09/MF A02; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

In both military and civilian helicopters, it is necessary to monitor airspeed throughout the entire flight envelope. The determination of low airspeeds (less than 25 m/s) is a critical problem because of the limitations of classical anemometric sensors. A solution is proposed based on the derivation of longitudinal and transverse airspeeds from information already available aboard the helicopter: accelerations and attitude control information. The derivation algorithm, called MEDIA, is described along with the results of flight tests. Transl. by M.G.

N90-16745# Defence Research Establishment, Ottawa (Ontario).
THE DEVELOPMENT OF AN AIRBORNE SYNTHETIC APERTURE RADAR MOTION COMPENSATION SYSTEM
D. F. Liang and D. J. DiFilippo *In* AGARD, Advances in Techniques and Technologies for Air Vehicle Navigation and Guidance Dec. 1989 13 p (For primary document see N90-16731 09-04)
Copyright Avail: NTIS HC A09/MF A02; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The Canadian Department of National Defence has developed an airborne Synthetic Aperture Radar Motion Compensation System (SARMCS) for the AN/APS-506 Maritime Search Radar. To attain high quality airborne SAR imagery, the SARMCS must provide accurate information on spurious motion of the antenna phase centre during a SAR scene. This information is used to compensate the radar returns, thereby enhancing the SAR image quality. The SARMCS is effectively an integrated navigation system consisting of a ring laser gyro inertial navigation system (LTN-91), a Decca Doppler radar, a baro-altimeter, and a motion compensation inertial measurement subsystem (MCIMS). The hardware and software configurations of the SARMCS implemented on board a Convair 580 research aircraft are described. In addition, the flight testing approach and some of the simulation and flight test results are presented. Author

N90-16746# Defence Research Establishment Suffield, Ralston (Alberta).
GUIDANCE AND CONTROL CONSIDERATIONS FOR A MANEUVERING AERIAL TARGET SYSTEM
Alex B. Markov, Robert W. Herring, and Eric N. Solowka (Atlantis Flight Research, Inc., Brampton, Ontario) *In* AGARD, Advances in Techniques and Technologies for Air Vehicle Navigation and Guidance Dec. 1989 16 p (For primary document see

N90-16731 09-04)
Copyright Avail: NTIS HC A09/MF A02; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

In 1981 the Defence Research Establishment Suffield (DRES) initiated proof-of-concept (POC) development of a high subsonic, maneuvering fire-and-forget aerial target system named ROBOT-X. This effort was in response to a Canadian Navy requirement for aerial targets simulating low flying aircraft or anti-ship missiles, but has resulted in a target system that is also useful in many army low level air defence training scenarios. The POC development, recently completed, included seventeen POC test flights conducted at DRES. Of critical importance for ROBOT-X to meet its performance objectives is a programmable, cost-effective flight control system. The system that was developed, which was called MicroPilot, incorporates a number of software and hardware features that allow it to fulfill ROBOT-X guidance and control sensor suite, and facilitate implementation of algorithmic changes. This modularity has resulted in a flight control system that can also be used in other unmanned flight vehicles. A description is included of the ROBOT-X aerial target system. Guidance and control aspects are emphasized, and the methodology adopted in the flight control system design and prototyping is reviewed. MicroPilot algorithmic, software, and hardware features are described as they evolved in POC ROBOT-X development. Highlights of results from simulation, testbed aircraft trials and POC ROBOT-X flight trials are given.
Author

N90-16747# Harris Corp., Melbourne, FL. Government Aerospace Systems Div.
TERRAIN-AIDED NAVIGATION AND TARGET ACQUISITION ON THE AFTI/F-16
Charles A. Baird, Noel Collins, and Myres Drew *In* AGARD, Advances in Techniques and Technologies for Air Vehicle Navigation and Guidance Dec. 1989 12 p (For primary document see N90-16731 09-04)
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The Advanced Fighter Technology Integration/F-16 (AFTI/F-16) aircraft is currently involved in flight testing aimed at developing technologies and capabilities to support the close air support (CAS) and battlefield air interdiction (BAI) missions The major features of CAS missions are illustrated. The CAS/BAI problem is described from a pilot's mission performance perspective. The integration of the aircraft system to utilize the terrain-aided navigation is described and passive ranging functions are provided by the Digital Terrain Management and Display Systems (DTMDS) to support the target acquisition and weapon delivery aspects of the CAS mission. Detailed presentation of the terrain-aided navigation flight test results and the analytical work supporting the passive ranging functions are then presented. This is followed by a description of the three phase CAS flight test program. The recently completed phase one is described, culminating in the flight demonstrations featured in the video presentation. The future program goals to be addressed in phases two and three of the CAS program are described. Author

N90-16748# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
MODELING THE EFFECTS OF THE USE OF GPS (GLOBAL POSITIONING SYSTEM) DERIVED ALTITUDE INDICATION IN THE C-17A AIRDROP SYSTEM M.S. Thesis
Thomas R. Kogler Dec. 1989 80 p
(AD-A215366; AFIT/GSO/ENS/89D-9) Avail: NTIS HC A05/MF A01 CSCL 15/6

The McDonnell-Douglas C-17A will use the Global Positioning System (GPS) for horizontal positioning during airdrops. ALthough GPS is capable of 3-D positioning, the primary reference for positioning in the vertical plane (altitude) is a barometric altimeter with an air data computer. The horizontal accuracy requirement with respect to the computed air release point (CARP) is 100 meters circular error probable (CEP). No accuracy requirement exists in the vertical plane. The purpose of this study is to determine if the vertical positioning provided by GPS allows for better airdrop performance, and to provide guidance in determining an accuracy requirement in the vertical plane. GRA

N90-16749# Aeronautical Research Labs., Melbourne (Australia).
SINS1: A MODEL OF A STRAPDOWN INERTIAL NAVIGATION SYSTEM
R. B. Miller Jul. 1989 57 p
(AD-A215495; ARL-SYS-TM-101; DODA-AR-004-594) Avail: NTIS HC A04/MF A01 CSCL 17/7

The SINS1 is a simulation of a strapdown inertial navigation system (INS) written as a FORTRAN subroutine to be called at intervals by another program. Sensor errors, system initialization characteristics, and navigation algorithm operation may be selected by the user. Each call corresponds to the passage of a set time interval, and the calling program provides environmental dynamics information about the angular velocity of, and specific force on, the simulated INS. As required by the user, the calling program obtains from SINS1, the INS outputs of position, attitude, velocity, and other data. An example of a calling program is also described. GRA

N90-16750# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
APPLICATION OF MODEL BASED REASONING TO DIAGNOSIS OF FAULTS IN INERTIAL NAVIGATION EQUIPMENT M.S. Thesis
Raymond E. Yost Dec. 1989 135 p
(AD-A215561; AFIT/GCS/ENG/89D-19) Avail: NTIS HC A07/MF A01 CSCL 17/7

In 1988 Skinner produced the Blended Diagnostic System (BDS) which was an attempt to provide the Aerospace Guidance and Metrology Center (AGMC) with an expert system capable of diagnosing faults in the Dual Miniature Inertial Navigation System (DMINS). Skinner proposed the blending of a traditional rule-based system with a model-based system. The techniques used to perform the model-based reasoning in BDS are however primitive compared to other techniques currently available. The development is described of a model-based diagnostic system using techniques pioneered by Randall Davis, and substantially more sophisticated than those used in BDS. A diagnostic prototype for the DMINS was developed which provides a more thorough and consistent diagnosis than does Skinner's model-based system. The models in the prototype were created using the Intelligent Diagnostic Expert Assistant (IDEA) software developed by AI Squared Inc., of North Chelmsford MA. IDEA is based on extensive research by Davis.
GRA

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.*For land transportation vehicles see *85 Urban Technology and Transportation.*

N90-16751*# Kansas Univ., Lawrence.
PRELIMINARY DESIGN OF A FAMILY OF THREE CLOSE AIR SUPPORT AIRCRAFT
Brian Cox, Paul Darrah, Wayne Lussier, and Nikos Mills 17 May 1989 342 p
(NASA-CR-186070; NAS 1.26:186070) Avail: NTIS HC A15/MF A02 CSCL 01C

A family of three Close Air Support aircraft is presented. These aircraft are designed with commonality as the main design objective to reduce the life cycle cost. The aircraft are low wing, twin-boom, pusher turbo-prop configurations. The amount of information displayed to the pilot was reduced to a minimum to greatly simplify the cockpit. The aircraft met the mission specifications and the

performance and cost characteristics compared well with other CAS aircraft. The concept of a family of CAS aircraft seems viable after preliminary design. Author

N90-16752# Aerospace Medical Research Labs., Wright-Patterson AFB, OH.
AN ILLUSTRATED GUIDE OF OPTICAL CHARACTERISTICS OF AIRCRAFT TRANSPARENCIES Final Report, Feb. 1988 - Feb. 1989
Harold S. Merkel and Harry L. Task Mar. 1989 35 p Original contains color illustrations
(AD-A214565; AAMRL-TR-89-015) Avail: NTIS HC A03/MF A01 CSCL 01/3

Aircraft transparencies are susceptible to numerous optical characteristics which may impact the visual performance of the aircrew. These characteristics range in severity from simply distracting to hazardous. This report describes and illustrates the ten most common of these optical characteristics. It may be used as a guide by aircrews, maintenance personnel, and others working with transparencies to assist them in accurately identifying transparency optical defects. GRA

N90-16753# Naval Postgraduate School, Monterey, CA. Dept. of Aeronautics and Astronautics.
APPLICATIONS OF MODERN CONTROL THEORY SYNTHESIS TO A SUPER-AUGMENTED AIRCRAFT M.S. Thesis
Walter L. Rogers Jun. 1989 165 p
(AD-A215431) Avail: NTIS HC A08/MF A01 CSCL 12/9

The singular value Bode plot of return difference and loop gain matrices have emerged as useful indicators of multivariable robustness. The H infinity and H2 control theories provide a systematic procedure for shaping the singular value loop gains of a multivariable feedback control system. It is shown that H infinity control theory, using specified performance objectives and stability constraints, is effective in synthesizing a stabilizing controller for the statically unstable longitudinal dynamics of the X-29. H infinity control synthesis also demonstrates a good ability to cope with a true multivariable design problem such as the multiple, independently controlled surfaces of a super-maneuverable aircraft. However, it is also shown that the control surface deflections and control rates necessary to effect the specified performance levels exceed the performance capabilities of the X-29's actuators. A work-around to the limited actuator performance is provided by penalizing the control input vector more heavily during the problem formulation. This approach, while reducing the actuator performance requirements, results in a limited performance X-29. GRA

N90-16754# Aerolift, Inc., Tillamook, OR.
FURTHER DEVELOPMENT AND LIMITED FLIGHT TESTING OF THE CYCLOCRANE Quarterly Technical Report No. 4, 1 Apr. - 30 Jun. 1989
30 Jun. 1989 76 p
(Contract MDA972-88-C-0058; ARPA Order 6390)
(AD-A215519) Avail: NTIS HC A05/MF A01 CSCL 01/3

The basic scope of this program is to identify military missions, develop design configurations, refurbish and modify the existing CycloCrane, demonstrate operational procedures, and develop program plan. A detailed plan for the implementation of the present program has been developed and the costs and schedules associated with the plan are being monitored and managed. Due to a redirection of focus mandated by DARPA, the mission analysis element of the program was terminated on June 30, 1989. Because of this redirection, several high-probability military missions had to be abandoned. The refurbishment task is essentially complete, the remaining major tasks being adjustment of the aircraft flight controls and the rigging. Modification tasks completed during the quarter include the design and stress analysis of the Y tail and fabrication of approximately half of the detail parts for same. The hydraulic system was inspected and checked, most engine tests were completed, and bench tests of the avionics systems are complete. The flight test plan was cleared for open publication in May. Although there has been some slippage, this document will serve as AeroLift's primary document for conducting the limited flight tests. As of June 30, AeroLife had tested and modified the Hirth F-30 engine. GRA

N90-16755# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
EXPERIMENTAL EVALUATION OF IMPEDANCE CONTROL FOR ROBOTIC AIRCRAFT REFUELING M.S. Thesis
Vernon W. Milholen 14 Dec. 1989 112 p
(AD-A215532; AFIT/GE/ENG/89D-32) Avail: NTIS HC A06/MF A01 CSCL 01/3

The robotics program at AFIT is quite advanced in the areas of interest to the Air Force such as human arm emulation and robotic assisted aircraft turnaround. Compliant motion is an enabling technology for these efforts that will prove useful in other applications as well. The refueling task provided the impetus for future development that may soon be used in grasping operations and of course, the completion of the impedance control algorithm implementation. The goals were essentially to build on the foundation laid in previous work by Capt David Duvall and advance the development he began. Specifically, two things were sought: a refueling demonstration, and a more user friendly environment for future progress. GRA

N90-16756# Army Aviation Research and Development Command, Moffett Field, CA. Aeroflightdynamics Directorate.
THE RESPONSE OF HELICOPTER ROTORS TO VIBRATORY AIRLOAD
William G. Bousman 14 Nov. 1989 20 p
(AD-A215678) Avail: NTIS HC A03/MF A01 CSCL 01/3

Structural response data from flight or wind tunnel tests of eight full scale rotors were examined and compared for high speed flight conditions and in the absence of blade stall or maneuvers. Both similarities and differences in the behavior of the rotors were observed, and these findings are useful in determining appropriate tests for development of theoretical methods. Limited use is made of airload measurements and theoretical calculation in examining these data. Major similarities observed in the rotor behavior include: (1) 3/rev vibratory flap bending moments are remarkably similar among all the rotors at high speed; (2) the root oscillatory chord bending induced by lag dampers is similar for three of the articulated rotors despite differences in the damper type; and (3) torsion moment and pitch-link loads show some positive-negative loading over the advancing side of the disk caused by the unsteady pitching moments at the blade tip. Differences that were observed include: (1) the vibratory chord bending moment behavior appears to be dependent on rotor stiffness in part, but differences seen are not easily explained; (2) the CH-53A root oscillatory chord bending moment data do not show the damper induced loads that are seen on the other articulated rotors with hydraulic lag dampers; and (3) the AH-1G torsion response is very different from that of the articulated rotors. GRA

N90-16757 ESDU International Ltd., London (England).
BODY EFFECT ON WING ANGLE OF ATTACK AND PITCHING MOMENT AT ZERO LIFT AT LOW SPEEDS Abstract Only
Nov. 1989 18 p Supersedes ESDU-Aero-A.08.01.07
(ESDU-89042; ISBN-0-85679-715-4; ISSN-0141-397X) Avail: ESDU

ESDU 89042 gives simple empirical methods of predicting the change in zero-lift angle and in pitching moment at zero lift due to adding a fuselage of approximately circular section to a swept, cambered and twisted wing. The effects of wing height and of body asymmetry in the aircraft plane of symmetry are considered. It was found that neither Reynolds number nor Mach number below 0.4 was important. Sketches compare both the predicted changes and the values for the wing-body combination with experimental results used in the correlation, and it is found that zero lift angle of attack is predicted to within 0.3 degrees and pitching moment coefficient (based on gross wing area and aerodynamic mean chord) to within 0.1. A worked example illustrates the use of the method, using ESDU 87031 and 87001

to predict wing alone values of zero lift angle of attack and pitching moment respectively, although of course experimental values could be used if available. ESDU

N90-16801# Air Force Systems Command, Wright-Patterson AFB, OH.
NATIONAL AERO-SPACEPLANE STATUS AND PLANS
Tom J. Gregory and H. Wright *In* ESA, Progress in Space Transportation Aug. 1989 p 149-15 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

N90-16803# British Aerospace Public Ltd. Co., Stevenage (England). Space Systems Group.
COST OPTIMISATION OF REUSABLE AEROSPACEPLANE TRANSPORTATION SYSTEMS
Robert C. Parkinson *In* ESA, Progress in Space Transportation Aug. 1989 p 163-16 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

N90-16758*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, CA.
PRELIMINARY RESULTS FROM A SUBSONIC HIGH ANGLE-OF-ATTACK FLUSH AIRDATA SENSING (HI-FADS) SYSTEM: DESIGN, CALIBRATION, AND FLIGHT TEST EVALUATION
Stephen A. Whitmore, Timothy R. Moes, and Terry J. Larson (Analytical Mechanics Associates, Inc., Hampton, VA.) Jan. 1990 13 p Presented at the 28th AIAA Aerospace Sciences Meeting, Reno, NV, 8-11 Jan. 1990 Previously announced in IAA as A90-19746
(NASA-TM-101713; H-1583; NAS 1.15:101713; AIAA-90-0232)
Avail: NTIS HC A03/MF A01 CSCL 01D

A nonintrusive high angle-of-attack flush airdata sensing (HI-FADS) system was installed and flight-tested on the F-18 high alpha research flight vehicle. The system is a matrix of 25 pressure orifices in concentric circles on the nose of the vehicle. The orifices determine angles of attack and sideslip, Mach number, and pressure altitude. Pressure was transmitted from the orifices to an electronically scanned pressure module by lines of pneumatic tubing. The HI-FADS system was calibrated and demonstrated using dutch roll flight maneuvers covering large Mach, angle-of-attack, and sideslip ranges. Reference airdata for system calibration were generated by a minimum variance estimation technique blending measurements from two wingtip airdata booms with inertial velocities, aircraft angular rates and attitudes, precision radar tracking, and meteorological analyses. The pressure orifice calibration was based on identifying empirical adjustments to modified Newtonian flow on a hemisphere. Calibration results are presented. Flight test results used all 25 orifices or used a subset of 9 orifices. Under moderate maneuvering conditions, the HI-FADS system gave excellent results over the entire subsonic Mach number range up to 55 deg angle of attack. The internal pneumatic frequency response of the system is accurate to beyond 10 Hz. Aerodynamic lags in the aircraft flow field caused some performance degradation during heavy maneuvering. Author

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxilliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N90-16759# Oxford Univ. (England). Dept. of Engineering Sciences.
WAKE INTERACTION EFFECTS ON THE TRANSITION PROCESS ON TURBINE BLADES Final Report, 1 Sep. 1985 - 31 Dec. 1988
R. W. Ainsworth and J. E. LaGraff (Syracuse Univ., NY.) Sep. 1989 16 p
(Grant AF-AFOSR-0295-85; AF Proj. 2307)
(AD-A214492; AFOSR-89-1342TR) Avail: NTIS HC A03/MF A01 CSCL 20/4

The unsteady behavior of a 2-D gas turbine rotor blade boundary layer was observed using wide bandwidth surface heat transfer thin film gauges. The tests were conducted in a compression heated short duration wind tunnel cascade at realistic gas turbine aero/thermo-dynamic conditions. Wake passage effects were generated using a rotating set of upstream bars. The unsteadiness of the wake and shock interactions were observed through the effects on temporally and spatially accurate heat transfer measurements. GRA

N90-16760# Aeronautical Research Labs., Melbourne (Australia).
THE DEVELOPMENT OF A T53-L11 ENGINE COMPUTER MODEL Propulsion Technical Memorandum
J. Faragher Apr. 1989 42 p
(AD-A214533; ARL-PROP-TM-453; DODA-AR-005-587) Avail: NTIS HC A03/MF A01 CSCL 21/5

This Technical Memorandum describes the development of a steady-state engine model for a Lycoming T53 turboshaft engine. A genuine compressor map obtained from Lycoming was integrated into a generic gas turbine modelling program called Turbotrans. Both engine performance predictions and the variation of output power with free turbine speed showed good correlation with manufacturer's data. The ability to simulate engine wear and damage via degraded component efficiencies was demonstrated but not validated. GRA

N90-16761# Naval Postgraduate School, Monterey, CA. Dept. of Aeronautics.
INVESTIGATION INTO THE FEASIBILITY OF USING SOLID FUEL RAMJETS FOR HIGH SUPERSONIC/LOW HYPERSONIC TACTICAL MISSILES M.S. Thesis
Michael A. Witt Jun. 1989 62 p
(AD-A214737) Avail: NTIS HC A04/MF A01 CSCL 21/8

An investigation was conducted to determine the feasibility of using solid fuel ramjets as propulsion units on high supersonic low hypersonic tactical missiles. Experiments were conducted on two types of configurations. Plexiglas was used as the fuel in a scramjet and HTPB was used as the fuel in a dual mode combustor. Results indicated that supersonic combustion occurred in both configurations, but that mixing the heat addition losses were high. Ignition limits were identified as a possible limiting factor in the use of solid fuels for the proposed application. Combustion kinetics were shown to be rapid enough to support sustained combustion in supersonic flow. GRA

N90-16762# Army Aviation Systems Command, Saint Louis, MO.
USING GOAL PROGRAMMING TO DETERMINE THE OPTIMAL ENGINE MIX FOR UH-1 HELICOPTERS
Kimberly S. Schenken 8 Aug. 1989 49 p
(AD-A214893) Avail: NTIS HC A03/MF A01 CSCL 12/4

This paper presents a methodology for using Sequential Linear

Goal Programming to determine the optimal decision when decision makers have conflicting goals. An example is presented to demonstrate the technique. The demonstration problem is whether the UH-1 Helicopter's engine should be rebuilt or replaced with a modern engine. The Army has several conflicting criteria to consider in this decision. For example, they want to minimize both investment cost and operating and support costs, and maximize the performance of the weapon system. This paper illustrates how goal programming is useful in highlighting trade-offs in decisions, and in demonstrating to decision makers the effect of postponing cost reducing improvements to weapon systems. The disadvantage of goal programming is that the formulation of the problem is complex and many problems may require too large a problem to be feasible. GRA

N90-16763# Dayton Univ., OH.
TURBINE BLADE DATA ACQUISITION SYSTEM USER'S GUIDE Final Report, Sep. 1985 - Aug. 1987
Michael Joseph Gutman May 1989 37 p
(Contract F33615-85-C-2585)
(AD-A214986; UDR-TR-87-128; WRDC-TR-89-2041) Avail: NTIS HC A03/MF A01 CSCL 21/5

Design and technical documentation on the noncontacting stress measurement system is presented. This system acquires blade tip deflection data via noncontacting optical sensors. The system utilizes computer-based data acquisition and storage hardware to provide real time vibration, as well as time history of blade vibration. GRA

N90-16764# Dayton Univ., OH. Electronic and Computer Development Lab.
TURBINE BLADE DATA ACQUISITION SYSTEM SOFTWARE REFERENCE Final Report, Sep. 1985 - Aug. 1987
Michael Joseph Gutman, Robert Edson Blanchard, James Michael Aulds, and Anthony Lee Shopu May 1989 84 p
(Contract F33615-85-C-2585; AF Proj. 3066)
(AD-A215134; UDR-TR-87-134; WRDC-TR-89-2042) Avail: NTIS HC A05/MF A01 CSCL 21/5

This report contains design and technical documentation on magnetic tape format, master and slave program software, and the simulator EPROM listings for the noncontacting stress measurement system. This system is used as an analytical tool for structural testing and research on bladed disk components. The data acquisition software is used to control the operation of the signal storage and processing electronics. GRA

N90-16765# Dayton Univ., OH. Electronic and Computer Development Lab.
TURBINE BLADE DATA ACQUISITION SYSTEM TECHNICAL REFERENCE Final Report, Sep. 1985 - Aug. 1987
Michael Joseph Gutman May 1989 51 p
(Contract F33615-85-C-2585; AF Proj. 3066)
(AD-A215135; UDR-TR-87-133; WRDC-TR-89-2040) Avail: NTIS HC A04/MF A01 CSCL 21/5

This report contains design and technical documentation on the noncontacting stress measurement system. This system is used as an analytical tool for structural testing and research on bladed-disk components. This report shows artwork, schematics and block diagrams plus parts list. GRA

N90-16766# Institut Franco-Allemand de Recherches, Saint-Louis (France).
EXPERIMENTAL STUDY OF VELOCITY FIELDS AND TURBULENCE IN A TURBOJET ENGINE [ETUDE EXPERIMENTALE DES CHAMPS DE VITESSE ET DE TURBULENCE D'UN JET DE TURBOREACTEUR]
H. J. Schaefer 29 Sep. 1988 18 p In FRENCH Presented at Journees Francaises d'Anenometrie Laser, Marseille, France, 21-23 Sep. 1988 Original contains color illustrations
(ISL-CO-231/88; ETN-90-96090) Avail: NTIS HC A03/MF A01

Laser velocimetry is used to measure the velocity and turbulence profiles in a hot jet from the Microturbo TRS 18 turbo reactor. The ejection velocity is between 265 and 520 m/s and the temperatures are 820 to 960 K. Signal treatment is made with equipment developed for high velocity flow data processing. TiO2 is employed as a tracer. The results are in good agreement with a theoretical model previously developed. ESA

N90-16817# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Corbeil (France).
PROGRESS IN AIRBREATHING COMBINED ENGINES FOR FUTURE EUROPEAN LAUNCHER
Michel Doublier, P. Ramette, and D. Scherrer (Office National d'Etudes et de Recherches Aerospatiales, Paris, France) *In* ESA, Progress in Space Transportation Aug. 1989 p 279-28 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

N90-16818# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.).
SAENGER PROPULSION SYSTEM OPTIONS
Norbert Voss and Martin Albers (Motoren- und Turbinen-Union Muenchen G.m.b.H., Germany, F.R.) *In* ESA, Progress in Space Transportation Aug. 1989 p 287-29 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

N90-16819# Rolls-Royce Ltd., Bristol (England).
PARAMETRIC ASSESSMENT OF PROPULSION SYSTEM MASS FOR AIRBREATHING LAUNCHER CONFIGURATIONS
F. A. Hewitt and Rainer R. Schwab *In* ESA, Progress in Space Transportation Aug. 1989 p 293-29 Sponsored in part by ESA (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

N90-16767*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
RESULTS OF AIRCRAFT OPEN-LOOP TESTS OF AN EXPERIMENTAL MAGNETIC LEADER CABLE SYSTEM FOR GUIDANCE DURING ROLL-OUT AND TURNOFF
W. Thomas Bundick, David B. Middleton, and William L. Poole Washington Feb. 1990 40 p
(NASA-TM-4135; L-16574; NAS 1.15:4135) Avail: NTIS HC A03/MF A01 CSCL 01C

An experimental magnetic leader cable (MLC) system designed to measure aircraft lateral displacement from centerline and heading relative to centerline during rollout, turnoff, and taxi was tested at NASA's Wallops Flight Facility using NASA's Transport System Research Vehicle (TSRV), a modified B-737. The MLC system consisted of ground equipment that produced a magnetic field about a wire along runway centerline and airborne equipment that detected the strength and direction of this field and computed displacement and heading. Results of these tests indicate that estimates of aircraft displacement from centerline produced by the magnetic leader cable system using either of the two algorithms appear to be adequate for use by an automatic control system during rollout, turnoff, and taxi. Estimates of heading, however, are not sufficiently accurate for use, probably because of distortion of the magnetic field by the metal aircraft. Author

N90-16768*# Boeing Commercial Airplane Co., Seattle, WA.
DESIGN OF INTEGRATED PITCH AXIS FOR AUTOPILOT/AUTOTHROTTLE AND INTEGRATED LATERAL AXIS FOR AUTOPILOT/YAW DAMPER FOR NASA TSRV AIRPLANE USING INTEGRAL LQG METHODOLOGY Final Report
Isaac Kaminer, Russell A. Benson, Edward E. Coleman, and

Yaghoob S. Ebrahimi Washington Jan. 1990 152 p
(Contract NAS1-18027)
(NASA-CR-4268; NAS 1.26:4268) Avail: NTIS HC A08/MF A01 CSCL 01C

Two designs are presented for control systems for the NASA Transport System Research Vehicle (TSRV) using integral Linear Quadratic Gaussian (LQG) methodology. The first is an integrated longitudinal autopilot/autothrottle design and the second design is an integrated lateral autopilot/yaw damper/sideslip controller design. It is shown that a systematic top-down approach to a complex design problem combined with proper application of modern control synthesis techniques yields a satisfactory solution in a reasonable period of time. Author

N90-16769*# Auburn Univ., AL. Dept. of Algebra, Combinatorics, and Analysis.
A METHOD FOR THE EARLY DETECTION OF INSTABILITIES IN ROTORDYNAMICS Report, 27 Dec. 1988 - 26 Dec. 1989
Richard A. Zalik 1989 19 p
(Grant NAG8-119)
(NASA-CR-186307; NAS 1.26:186307) Avail: NTIS HC A03/MF A01 CSCL 01C

For a simple Jeffcott model with deadband, a method is developed to determine stability margins by an analysis of the Discrete Fourier transform of the system response. The viability of this method is demonstrated by means of numerical simulations. The circular behavior of the system response on the stability boundary is also explained. Author

N90-16770# Georgia Inst. of Tech., Atlanta. School of Electrical Engineering.
ESTIMATION AND CONTROL OF NONLINEAR AND HYBRID SYSTEMS WITH APPLICATIONS TO AIR-TO-AIR GUIDANCE Final Report, 1 Aug. 1987 - 31 Mar. 1989
A. H. Haddad and E. I. Verriest 31 Mar. 1989 169 p
(Grant AF-AFOSR-0308-87; AF Proj. 2304)
(AD-A214542; AFOSR-89-1339TR) Avail: NTIS HC A08/MF A01 CSCL 17/7

The research covered several aspects of the basic issues that are needed to develop and implement nonlinear and hybrid systems schemes for the filtering, tracking, and control of maneuvering vehicles in an uncertain and nonlinear geometry. It is based on the approximation of the original nonlinear problem by a switched Markov linear models which in turn lead to hybrid model formulation or to piecewise linear approximations. Four aspects are considered: (1) Approaches to handling hybrid systems models; (2) Fast and slow decomposition for piecewise linear systems; (3) Estimation in the presence of impulsive inputs that can serve as either models for the switching behavior or the changes in maneuvers; and (4) Modeling, parameterization, and realization issues for hybrid systems. Applications to nonlinear filtering and tracking schemes and their implementation is also addressed. GRA

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N90-16771*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
HIGH-PRESSURE PROMOTED COMBUSTION CHAMBER Patent Application
Michelle A. Rucker, inventor (to NASA) and Joel M. Stoltzfus, inventor (to NASA) 18 Jul. 1989 19 p
(NASA-Case-MSC-21470-1; US-Patent-Appl-SN-381239; NAS 1.71:MSC-21470-1) Avail: NTIS HC A03/MF A01 CSCL 14B

In the preferred embodiment of the promoted combusiton chamber disclosed herein, a thick-walled tubular body that is capable of withstanding extreme pressures is arranged with removable upper and lower end closures to provide access to the chamber for dependently supporting a test sample of a material being evaluated in the chamber. To facilitate the real-time analysis of a test sample, several pressure-tight viewing ports capable of withstanding the simulated environmental conditions are arranged in the walls of the tubular body for observing the test sample during the course of the test. A replaceable heat-resistant tubular member and replaceable flame-resistant internal liners are arranged to be fitted inside of the chamber for protecting the interior wall surfaces of the combustion chamber during the evaluation tests. Inlet and outlet ports are provided for admitting high-pressure gases into the chamber as needed for performing dynamic analyses of the test sample during the course of an evaluation test. NASA

N90-16772# Anacapa Sciences, Inc., Fort Rucker, AL.
BACKWARD TRANSFER AND SKILL ACQUISITION IN THE AH-1 FLIGHT AND WEAPONS SIMULATOR Interim Report, Oct. 1986 - Nov. 1988
George L. Kaempf, Kenneth D. Cross, and N. Joan Blackwell (Army Research Inst. Aviation Research and Development Activity, Fort Rucker, AL.) Aug. 1989 98 p
(Contract MDA903-87-C-0523)
(AD-A213432; ASI690-312-88; ARI-RR-1537) Avail: NTIS HC A05/MF A01 CSCL 05/6

Two experiments were conducted, one to investigate the backward transfer of flight skills to the AH-1 Flight and Weapons Simulator (AH1FWS) and another to investigate the acquisition of flight skills in the AH1FWS on selected maneuvers. In the backward transfer research, 16 AH-1 instructor pilots (IPs) from the AH-1 Aircrew Qualification Course were administered checkrides in the AH1FWS and the AH-1F aircraft. Comparison of the performance data from the two checkrides indicates that, while proficient on the maneuvers in the AH-1F, all IPs performed poorly in the AH1FWS. The IPs attributed their difficulties in the AH1FWS to deficiencies in the visual system and the handling and response characteristics of the flight controls. In the skill acquisition research, four groups of 10 operational aviators received training in the AH1FWS. Each group received training on a different set of five maneuvers. The training comprised 10 practice trials for each maneuver. Subjects received no feedback on trials 1-3; IPs provided instruction on trials 4-10. Mean performance ratings did not reach a satisfactory level of proficiency within the 10 practice trials for 17 of the 20 maneuvers investigated. Furthermore, the backward transfer data obtained during the skill acquisition research were consistent with similar data collected in a previous study. GRA

N90-16773# Southwest Research Inst., San Antonio, TX.
CUMULATIVE AIRPORT NOISE EXPOSURE METRICS: AN ASSESSMENT OF EVIDENCE FOR TIME-OF-DAY WEIGHTINGS, REVISION
James M. Fields Nov. 1989 180 p
(AD-A214878; DOT/FAA/EE-86/10-Rev) Avail: NTIS HC A09/MF A02 CSCL 20/1

The differential impact of noise on residents at different times of day is examined in analyses of the original machine-readable data from ten community surveys and in detailed reviews of the published results from 20 additional surveys. Analyses are conducted using alternative community response measures and analysis techniques. The primary objective of these analyses is to determine the relative impact of noise during the daytime and nighttime by estimating the value of a time-day weighting in the adjusted energy model. Some support is found for nighttime and evening weightings, however, the estimates of these time-of-day weightings are found to be highly accurate. Examinations of the factors affecting this accuracy lead to the conclusion that studies of community response to noise will not provide a usefully accurate estimation of the time-of-day weighting parameter in the adjusted energy model. Data is provided on proportions of the United States population engaged in noise-sensitive activities at different times of day. All social survey results are reproduced in which averages of nighttime response are plotted by nighttime noise levels.

Analyses are conducted of the relationship between daytime and nighttime noise environments around United States airports.
GRA

N90-16774# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
IMPLEMENTATION OF ADAPTIVE ARRAYS IN THE BLOCK ORIENTED SYSTEMS SIMULATOR M.S. Thesis
Joe H. Srubar Dec. 1989 154 p
(AD-A215545; AFIT/GE/ENG/89D-51) Avail: NTIS HC A08/MF A01 CSCL 09/1

The Information Transmission Branch of the Wright Research and Development Center wants to have a tool to evaluate contractor's proposals concerning adaptive arrays. This tool could be the traditional component level simulation which is difficult to modify and is generally applicable to only one array configuration. This study investigated the feasibility of implementing adaptive array algorithms in a simulation program called the Block Oriented Systems Simulator (BOSS). Two algorithms in particular were used: the least mean square (LMS) algorithm in real and complex form originally developed by Widrow, et. al. and the Applebaum algorithm. Two arrays were simulated with simple isotropic radiators used as the array elements. The first array used two elements spaced one half wavelength apart. The second array used four elements with variable geometry. The approach taken was to first implement the algorithms and arrays in the simulation language.
GRA

N90-16843# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.).
AERODYNAMIC SIMULATION CONDITIONS IN ARC HEATED WIND TUNNELS
Knut Kindler *In* ESA, Progress in Space Transportation Aug. 1989 p 501-50 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see 91 Lunar and Planetary Exploration.

N90-16775*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
GET AWAY SPECIAL: THE FIRST TEN YEARS
1989 46 p Original contains color illustrations Contains news release as supplement
(NASA-TM-102921; NAS 1.15:102921) Avail: NTIS HC A03/MF A01 CSCL 22A

NASA's Get Away Special Program (GAS) has been unique in the aerospace world for the exceptional range of nonprofessional and professional experimenters who have gained access to space through it. Presented is a compilation of the experiences gained during the first 10 years of the program. The brief history begins with the origins of the GAS program and continues with the milestones in the program's development. Overviews are presented of the individual customer payloads which are chronologically grouped with their respective Shuttle missions. E.R.

N90-16776*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SCIENCE EXPLORATION OPPORTUNITIES FOR MANNED MISSIONS TO THE MOON, MARS, PHOBOS, AND AN ASTEROID
Douglas B. Nash, Jeffrey Plescia, Mark Cintala, Joel Levine, Paul Lowman, Rocco Mancinelli, Wendell Mendell, Carol Stoker, and Steven Suess (National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.) 30 Jun. 1989 60 p
(Contract NAS7-918)
(NASA-CR-186295; NAS 1.26:186295; JPL-Publ-89-29) Avail: NTIS HC A04/MF A01 CSCL 22A

Scientific exploration opportunities for human missions to the Moon, Phobos, Mars, and an asteroid are addressed. These planetary objects are of prime interest to scientists because they are the accessible, terresterial-like bodies most likely to be the next destinations for human missions beyond Earth orbit. Three categories of science opportunities are defined and discussed: target science, platform science, and cruise science. Target science is the study of the planetary object and its surroundings (including geological, biological, atmospheric, and fields and particle sciences) to determine the object's natural physical characteristics, planetological history, mode of origin, relation to possible extant or extinct like forms, surface environmental properties, resource potential, and suitability for human bases or outposts. Platform science takes advantage of the target body using it as a site for establishing laboratory facilities and observatories; and cruise science consists of studies conducted by the crew during the voyage to and from a target body. Generic and specific science opportunities for each target are summarized along with listings of strawman payloads, desired or required precursor information, priorities for initial scientific objectives, and candidate landing sites. An appendix details the potential use of the Moon for astronomical observatories and specialized observatories, and a bibliography compiles recent work on topics relating to human scientific exploration of the Moon, Phobos, Mars, and asteroids. It is concluded that there are a wide variety of scientific exploration opportunities that can be pursued during human missions to planetary targets but that more detailed studies and precursor unmanned missions should be carried out first. Author

N90-16777*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A PLANNING AND SCHEDULING LEXICON
Jennifer W. Cruz and William C. Eggemeyer 15 Sep. 1989 45 p
(Contract NAS7-918)
(NASA-CR-186061; NAS 1.26:186061; JPL-Publ-89-25) Avail: NTIS HC A03/MF A01 CSCL 22A

A lexicon related to mission planning and scheduling for spacecraft is presented. Planning and scheduling work is known as sequencing. Sequencing is a multistage process of merging requests from both the science and engineering arenas to accomplish the objectives defined in the requests. The multistage process begins with the creation of science and engineering goals, continues through their integration into the sequence, and eventually concludes with command execution onboard the spacecraft. The objective of this publication is to introduce some formalism into the field of spacecraft sequencing-system technology. This formalism will make it possible for researchers and potential customers to communicate about system requirements and capabilities in a common language. Author

N90-16784# European Space Agency, Paris (France).
THE EUROPEAN LONG-TERM SPACE PLAN: A BASIS FOR AUTONOMY AND COOPERATION
Reimar Luest *In its* Progress in Space Transportation Aug. 1989 p 9-13 Previously announced in IAA as A90-10291 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

N90-16788# Glavkosmos, Moscow (USSR).
GLAVKOSMOS U.S.S.R. AND THE BASIC OBJECTIVES OF ITS ACTIVITY
D. Y. Poletaev *In* ESA, Progress in Space Transportation Aug. 1989 p 45-49 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

N90-16845# Commission of the European Communities, Brussels (Belgium).
THE EUROPEAN SPACE EFFORT: AN INTEGRAL PART OF THE CONSTRUCTION OF EUROPE
Herbert Josef Allgeier *In* ESA, Progress in Space Transportation Aug. 1989 p 521-52 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

N90-16778*# Draper (Charles Stark) Lab., Inc., Cambridge, MA.
COOPERATIVE CONTROL OF TWO ACTIVE SPACECRAFT DURING PROXIMITY OPERATIONS M.S. Thesis - MIT
Robert J. Polutchko Aug. 1989 148 p
(Contract NAS9-18147)
(NASA-CR-185596; NAS 1.26:185596; CSDL-T-1037) Avail: NTIS HC A07/MF A01 CSCL 22A

A cooperative autopilot is developed for the control of the relative attitude, relative position and absolute attitude of two maneuvering spacecraft during on orbit proximity operations. The autopilot consists of an open-loop trajectory solver which computes a nine dimensional linearized nominal state trajectory at the beginning of each maneuver and a phase space regulator which maintains the two spacecraft on the nominal trajectory during coast phases of the maneuver. A linear programming algorithm is used to perform jet selection. Simulation tests using a system of two space shuttle vehicles are performed to verify the performance of the cooperative controller and comparisons are made to a traditional passive target/active pursuit vehicle approach to proximity operations. The cooperative autopilot is shown to be able to control the two vehicle system when both the would be pursuit vehicle and the target vehicle are not completely controllable in six degrees of freedom. The cooperative controller is also shown to use as much as 37 percent less fuel and 57 percent fewer jet firings than a single pursuit vehicle during a simple docking approach maneuver. Author

N90-16779# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
AN AUTONOMOUS ORBIT DETERMINATION SYSTEM FOR EARTH SATELLITES Ph.D. Thesis
Kerry D. Hicks Dec. 1989 229 p
(AD-A215671; AFIT/DS/AA/89-1) Avail: NTIS HC A11/MF A02 CSCL 17/7

A new system for autonomous satellite navigation is developed and investigated. Unlike many previous studies, however, this system is not limited to the determination of an earth satellite's current position. By using a two-step technique combined with a general perturbations model, this method allows the air-drag effect on the orbit to be estimated and applied to a future position prediction. Simulations using existing hardware have demonstrated that the algorithm presented is capable of current position estimates of sub-kilometer accuracy. Prediction precisions rival those of ground-based facilities: 8 to 12 kilometers two weeks in the future for low earth orbit. GRA

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

N90-16780# Lawrence Livermore National Lab., CA.
SUMMARY OF A DECADE OF RAILGUN DEVELOPMENT FOR HIGH-PRESSURE RESEARCH
R. S. Hawke, J. R. Asay (Sandia National Labs., Albuquerque, NM.), Cidellia Sanchez, ed., and Palmer T. VanDyke, ed. 28 Jun. 1989 8 p Presented at the 5th International Conference on Megagauss Magnetic Field Generation and Related Topics, Novosibirsk (USSR), 3-7 Jul. 1989
(Contracts W-7405-eng-48; DE-AC04-76DP-00789)
(DE90-005247; UCRL-100527; CONF-890710-25) Avail: NTIS HC A02/MF A01

For several decades the kinetic energy of fast-moving projectiles and plates (flat and cylindrical) was used to compress and heat matter and to compress magnetic fields. During this period the achievement of higher velocities has extended the accessible range of research to faster shockwaves, higher shockwave and isentropic pressures, higher material densities, more intense magnetic fields, etc. At present the fastest laboratory-size projectile accelerator is the two-stage light-gas gun (2SLGG), which accelerates projectiles to speeds between 8 and 9 km/s. Interest in electromagnetic launchers (EML) in general, and in railguns (RG) in particular, was motivated partly by the desire to reach even higher velocities. The status of railgun development is briefly reported, problems in attaining hypervelocities are described, and the STARFIRE project presented. DOE

N90-16826# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
HERMES GROUND OPERATION CONCEPTS
Fritz Gampe and Pierre Letalle (MATRA Espace, Toulouse, France) *In its* Progress in Space Transportation Aug. 1989 p 351-356
(For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

N90-16793# Department of Transportation, Washington, DC.
US COMMERCIAL LAUNCHER SUMMARY
Carl S. Rappaport *In* ESA, Progress in Space Transportation Aug. 1989 p 91-94 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

N90-16797*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ADVANCED MANNED LAUNCH SYSTEMS
Theodore A. Talay and W. D. Morris *In* ESA, Progress in Space Transportation Aug. 1989 p 117-12 Previously announced in IAA as A89-41041 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03 CSCL 22B

N90-16800# British Aerospace Public Ltd. Co., Stevenage (England). Space Systems Group.
HOTOL: A FUTURE LAUNCHER FOR EUROPE
Peter J. Conchie *In* ESA, Progress in Space Transportation Aug. 1989 p 143-14 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

N90-16807# National Space Development Agency, Tokyo (Japan).
DEVELOPMENT STATUS OF JAPAN'S NEW LAUNCH VEHICLE: H-2 ROCKET
M. Miyazawa, Y. Shibato, and Y. Fukushima *In* ESA, Progress in Space Transportation Aug. 1989 p 197-20 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

N90-16808# Centre National d'Etudes Spatiales, Paris (France).
THE ARIANE-5 PROGRAMME
Andre VanGaver *In* ESA, Progress in Space Transportation Aug. 1989 p 203-20 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

N90-16809# Messerschmitt-Boelkow-Blohm/Entwicklungsring Nord, Bremen (Germany, F.R.).
ARIANE-5 UPPER STAGE EPS
Horst Holsten and Juergen Kollien *In* ESA, Progress in Space Transportation Aug. 1989 p 207-21 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

N90-16814# British Aerospace Public Ltd. Co., Preston (England). Military Aircraft Div.
AERODYNAMIC AND STRUCTURAL DESIGN CHALLENGES OF A REUSABLE SINGLE STAGE TO ORBIT AIR-BREATHING LAUNCH VEHICLE
Brian R. A. Burns *In* ESA, Progress in Space Transportation Aug. 1989 p 255-26 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

N90-16828# Aerospatiale, Les Mureaux (France).
OPERATIONAL DRIVERS FOR LAUNCHER ARCHITECTURES
Henri Lacaze *In* ESA, Progress in Space Transportation Aug. 1989 p 367-37 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

N90-16830*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
SHUTTLE C: HEAVY-LIFT VEHICLE OF THE 1990'S
Thomas J. Lee *In* ESA, Progress in Space Transportation Aug. 1989 p 383-39 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03 CSCL 22B

N90-16832*# Aerospace Corp., Los Angeles, CA.
THE JOINT DOD/NASA ADVANCED LAUNCH SYSTEM (ALS) PROGRAMME
M. G. Wolfe *In* ESA, Progress in Space Transportation Aug. 1989 p 397-40 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03 CSCL 22B

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

N90-16781*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A TWO-STAGE EARTH-TO-ORBIT TRANSPORT WITH TRANSLATING OBLIQUE WINGS FOR BOOSTER RECOVERY Patent Application
Ian O. MacConochie, inventor (to NASA) and Charles A. Breiner, inventor (to NASA) (PRC Kentron, Inc., Hampton, VA.) 9 Nov. 1989 13 p Sponsored by NASA
(NASA-Case-LAR-14156-1; US-Patent-Appl-SN-433804; NAS 1.71:LAR-14156-1) Avail: NTIS HC A03/MF A01 CSCL 22B

A two-stage earth-to-orbit transport is disclosed which includes an orbiter vehicle and a pair of boosters, each having a deployable oblique wing located along a longitudinal axis of the booster. The wing is deployed in an oblique disposition in supersonic and hypersonic speeds, and disposed at 90 degree for subsonic speeds encountered during entry. The oblique wing is driven axially and rotated by means of a turret mounted on rails. NASA

N90-16782# European Space Agency, Paris (France).
PROGRESS IN SPACE TRANSPORTATION
T. D. Guyenne, ed. and J. J. Hunt, ed. Aug. 1989 512 p The 2nd European Aerospace Conference was held in Bonn Bad-Godesberg, Fed. Republic of Germany, 22-24 May 1989; sponsored by the AAAF, DGLR, Royal Aeronautical Society, and ESA
(ESA-SP-293; ISBN-92-9092-014-9; ISSN-0379-6566; ETN-90-96193) Copyright Avail: NTIS HC A22/MF A03

The ESA space programs are summarized and future plans outlined. Particular areas of interest in the articles are: operational space transportation systems, launch vehicles (present and future), and advanced technologies. An overview of the space transportation programs in the U.S., the USSR and Japan are presented. For individual titles, see N90-16783 through N90-16845.

N90-16783# Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.).
KEYNOTE ADDRESS
Heinz Riesenhuber *In* ESA, Progress in Space Transportation Aug. 1989 p 7-8 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

The success of the Ariane space venture is discussed. Plans for Ariane 4 and 5 are outlined. The importance of the Hermes space shuttle and of the Columbus space station is stressed. The specific plans of the Federal Republic of Germany in meeting these aerospace challenges is outlined. ESA

N90-16784# European Space Agency, Paris (France).
THE EUROPEAN LONG-TERM SPACE PLAN: A BASIS FOR AUTONOMY AND COOPERATION **c12**
Reimar Luest *In its* Progress in Space Transportation Aug. 1989 p 9-13 Previously announced in IAA as A90-10291 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

The long term space mission plans of ESA are outlined. The present status of the long term plan execution is presented. The Solar-Terrestrial Science program, the Hipparcos satellite, the Earth Remote Sensing satellite, the Ariane 5, Columbus, and Hermes programs are all looked at, and the progress made in each described. ESA

N90-16785# Arianespace, Evry (France).
THE INTERNATIONAL SPACE TRANSPORTATION MARKET: A EUROPEAN PERSPECTIVE
Klaus Iserland *In* ESA, Progress in Space Transportation Aug. 1989 p 15-20 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

The future of space transportation is examined in four areas: the launching of satellites and space probes, the launch of payloads for microgravity and technological experiments, the transport into low orbit of space structures, modules etc. used in building space stations, and later, space factories, and regular transport of men and materials to and from these stations and repair and maintenance missions. These four areas are analyzed in terms of their market aspects from a European viewpoint. Conclusions are made regarding the future structure of space transportation. ESA

N90-16786# European Space Agency, Paris (France).
ESA'S SPACE TRANSPORTATION PROGRAMME
Joerg Feustel-Bueechl *In its* Progress in Space Transportation Aug. 1989 p 23-37 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

The Ariane 5 development program is described. Its technical data sheet and component parts are presented. The Ariane 5 launch complex in Kourou, French Guiana, is described and illustrated. The schedule and cost of the Ariane 5 development scheme is given in detail. The objectives of the program are listed. Illustrations of the Hermes spaceplane and of the Hermes space suit for extra-vehicular activities are provided. A timetable for the different developmental projects is presented. Future plans beyond Ariane 5 and Hermes are presented. ESA

N90-16787*# National Aeronautics and Space Administration, Washington, DC.
UNITED STATES SPACE TRANSPORTATION SURVEY

Darrel R. Branscome *In* ESA, Progress in Space Transportation Aug. 1989 p 39-44 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03 CSCL 22B

Different developmental paths for the U.S. space transportation fleet are discussed. Development of a purely cargo, unmanned space shuttle, using many components of the present manned space shuttle system, is presented. Future manned spacecraft solutions are discussed. Launch vehicle programs for unmanned missions are described. The Titan solid rocket motor upgrade is identified as the biggest improvement in this area. A return to a better balance between manned and unmanned launch systems for space transportation is predicted. The Titan, Delta, Scout, and Pegasus families of rockets are described. The need to upgrade this fleet in meeting the space challenges of the future is stressed. ESA

N90-16788# Glavkosmos, Moscow (USSR).
GLAVKOSMOS U.S.S.R. AND THE BASIC OBJECTIVES OF ITS ACTIVITY **c12**
D. Y. Poletaev *In* ESA, Progress in Space Transportation Aug. 1989 p 45-49 (For primary document see N90-16782 09-16)
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The different roles of the Soviet government space organization Glavkosmos are described. These include organizing and coordinating work on the development and use of space technology in different areas. Fulfillment of USSR commitments in the development and use of space technology under agreements with foreign countries and organizations is described as a second role of Glavkosmos. Data is provided on the number of launches and success rates for the Proton, Soyuz, Vostok, Molnia, and Tsiklon rockets. The role of Glavkosmos in seeking better international cooperation is stressed. ESA

N90-16789# National Space Development Agency, Tokyo (Japan).
OVERVIEW OF JAPAN'S CURRENT AND FUTURE SPACE TRANSPORTATION PROGRAMMES
T. Godai, Tetsuij Narasaki, and Tetsuichi Ito *In* ESA, Progress in Space Transportation Aug. 1989 p 51-57 (For primary document see N90-16782 09-16)
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The Japanese space transportation program is reviewed. Concerning space science applications, a solid fuel four stage M-3S2 rocket is available. Concerning practical space applications a combined liquid and solid propulsion three stage H-1 rocket is available and a high performance, heavy lift two-stage H-2 rocket is under development. The first flight of the H-2 is planned for 1992. An outline of these three rockets is presented. Research and development towards future space transportation systems is presented, including work on HOPE (H-2 orbiting plane), and the HIMES (highly maneuvrable experimental space) vehicle. The conception and evolutionary role of each is described. ESA

N90-16790# Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.).
THE GERMAN HYPERSONIC TECHNOLOGY PROGRAMME
H. A. Hertrich *In* ESA, Progress in Space Transportation Aug. 1989 p 59-68 (For primary document see N90-16782 09-16)
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The Saenger hypersonic two stage fully reusable space transportation system is described. New technologies are predicted to allow such a fully reusable system to be implemented in the near future. The Saenger system is being developed to be the space transportation generation following the Ariane 5/Hermes system. The Saenger system involves a horizontal take-off winged lower stage using liquid hydrogen as fuel. It would carry on its back the upper stage Horus shuttle, a spaceplane with liquid hydrogen and liquid oxygen rocket propulsion. Stage separation would take place at an altitude of 30 km. The stages involved in developing the hypersonic lower stage are outlined. ESA

N90-16791# Glavkosmos, Moscow (USSR).
GLAVKOSMOS OPERATIONAL SPACE TRANSPORTATION SYSTEMS
Y. A. Smetanin *In* ESA, Progress in Space Transportation Aug. 1989 p 71-79 (For primary document see N90-16782 09-16)
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The expendable carrier rocket system currently in use in the USSR is described. Means of boosting payloads into near-Earth orbits with various orbital attitudes and injecting them into interplanetary trajectories are presented. Performance and service characteristics of Soviet and foreign carrier rockets are compared. ESA

N90-16792*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
AMERICA'S SHUTTLE RETURNS TO SPACE
Robert W. Moorehead *In* ESA, Progress in Space Transportation Aug. 1989 p 81-90 (For primary document see N90-16782 09-16)
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The Shuttle management structure, streamlined since the Challenger accident, is outlined. The associate administrators for space flight are identified and their responsibilities clearly spelled out. The NASA policy of assigning astronauts to management positions is described. A spaceflight safety panel is described. Non-managerial safety enhancement programs are outlined. These include: solid rocker booster changes, shuttle crew escape systems, and landing improvements. ESA

N90-16793# Department of Transportation, Washington, DC.
US COMMERCIAL LAUNCHER SUMMARY **c15**
Carl S. Rappaport *In* ESA, Progress in Space Transportation Aug. 1989 p 91-94 (For primary document see N90-16782 09-16)
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U.S. government policies on commercial launches are summarized. A progress report on the commercial launch industry in the U.S. is presented. Future prospects for the industry are commented upon. The role of the U.S. commercial launch industry in the mixed competitive and cooperative environment of space transportation is discussed. ESA

N90-16794# International Maritime Satellite Organization, London (England).
FINANCIAL AND COMMERCIAL ISSUES: A CUSTOMER'S PERSPECTIVE **c29**
Ramin Khadem *In* ESA, Progress in Space Transportation Aug. 1989 p 95-97 (For primary document see N90-16782 09-16)
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Cooperative approaches by satellite manufacturers and launch agencies to control and limit risks are outlined. The high level of risk associated with putting payloads in orbit is identified as having an inhibiting effect on the ultimate market. Ways of instilling customer confidence and of improving the viability of space projects are outlined. ESA

N90-16795# Leslie and Godwin Aviation Ltd., London (England).
LAUNCH INSURANCE: ITS ROLE IN THE FUTURE DEVELOPMENT OF COMMERCE IN SPACE **c83**
Antony A. M. Pinsent *In* ESA, Progress in Space Transportation Aug. 1989 p 99-107 (For primary document see N90-16782 09-16)
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The development of the satellite insurance market is described. Anticipated changes in the market to meet the demands of fast developing technology are outlined. Dependance on technical reliability and its relationship to the commitment of the insurance market is discussed. The balance between buyers insuring or self-insuring their risks is discussed. The ability of the insurance market to continue to provide the necessary scope of coverage and capacity in the future is discussed. ESA

N90-16796# Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.).
LEGAL ASPECTS OF COMMERCIAL SPACE TRANSPORTATION **c84**
Stephan F. vonWelck *In* ESA, Progress in Space Transportation Aug. 1989 p 109-11 (For primary document see N90-16782 09-16)
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The basic legal rules for commercial space transportation are presented. Two specific legal issues are given particular attention: the legal basis of the multinational Ariane space transportation system, and legal questions concerning future aerospaceplane transportation systems. Future launch vehicles such as the German Saenger, the British HOTOL and the U.S. National Aerospace Plane, bridging the gap between airflight and spaceflight, are predicted to create a special set of legal problems. Such problems are tentatively addressed. ESA

N90-16797*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ADVANCED MANNED LAUNCH SYSTEMS **c15**
Theodore A. Talay and W. D. Morris *In* ESA, Progress in Space Transportation Aug. 1989 p 117-12 Previously announced in IAA as A89-41041 (For primary document see N90-16782 09-16)
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Advanced Manned Launch Systems (AMLS) studies underway at the NASA Langley Research Center are described. The AMLS studies have focused on investigating mission needs and identifying technologies, operational requirements, and life-cycle costs. Two-stage vertical take off rocket vehicles with significant levels of reusability are shown to be cost effective for moderate to high flight rates. All-hydrogen fuel vehicles are preferred over methane boosted systems for both operational and cost considerations. Drawings of possible AMLS design solutions are presented. Fully reusable, partially resusable, expendable stage and horizontal take off airbreather/rocket solutions are compared. ESA

N90-16798# Centre National d'Etudes Spatiales, Paris (France).
FRENCH STUDIES ON ADVANCED SPACE TRANSPORTATION SYSTEMS
Jean-Claude Bouillot *In* ESA, Progress in Space Transportation Aug. 1989 p 129-13 (For primary document see N90-16782 09-16)
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The role of CNES in planning future space transportation systems is outlined. Evaluation studies of airframe and engine technology are described. Several options are being considered with special emphasis on single stage and two stage partly reusable vehicles. A number of possible engine cycles are investigated, with schedule priority being given to turbo-rocket and turbo-ram-rocket cycles. Whatever configuration is chosen, feasibility is marginal and better data is needed in such critical areas as air-intakes, aerodynamics, and engine components. ESA

N90-16799# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.).
PROGRESS IN SAENGER SPACE TRANSPORTATION SYSTEM DEFINITION
Dietrich E. Koelle *In* ESA, Progress in Space Transportation Aug. 1989 p 137-14 (For primary document see N90-16782 09-16)
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The progress made since mid 1988 in the Saenger space transportation system definition study is outlined. A Saenger configuration update is presented. The second stage Horus has been completely redesigned resulting in a smaller, more volume-efficient vehicle with more propellant and a higher mass margin. The stage separation procedure is described. The hypersonic flight demonstrator is mentioned. ESA

N90-16800# British Aerospace Public Ltd. Co., Stevenage (England). Space Systems Group.
HOTOL: A FUTURE LAUNCHER FOR EUROPE **c15**
Peter J. Conchie *In* ESA, Progress in Space Transportation Aug. 1989 p 143-14 (For primary document see N90-16782 09-16)
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The need for a European aerospace plane is presented. The role of HOTOL in raising the profile of such an aerospace plane is described. The current status of the HOTOL program is outlined. Diagrams of the HOTOL aerospace plane are presented. Vehicle configuration interactions, command and control issues, and aerodynamic design criteria are illustrated. Concerning budget, operational support systems are calculated to be the biggest single item in determining HOTOL costs. ESA

N90-16801# Air Force Systems Command, Wright-Patterson AFB, OH.
NATIONAL AERO-SPACEPLANE STATUS AND PLANS **c05**
Tom J. Gregory and H. Wright *In* ESA, Progress in Space Transportation Aug. 1989 p 149-15 (For primary document see N90-16782 09-16)
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Preliminary results of tests carried out in the design phase of the National Aero-Spaceplane Program are described. The fundamental economic considerations for the development of spaceplanes are reviewed. The advantages and disadvantages of international cooperation in the development of an aero-spaceplane are addressed. The importance of cost considerations in the design of the next generation of launch vehicles is stressed. ESA

N90-16802# VDK Systems, Brussels (Belgium).
COMPARISON BETWEEN HORIZONTALLY LAUNCHED AIR-BREATHING SINGLE AND TWO-STAGE TO ORBIT SPACE VEHICLES **c18**
Jean A. Vandenkerckhove *In* ESA, Progress in Space Transportation Aug. 1989 p 157-16 (For primary document see N90-16782 09-16)
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Three concepts of horizontally launched air-breathing space transportation vehicles are compared with respect to a common set of hypothetical requirements: two-stage-to-orbit vehicles, single-stage-to-orbit vehicles without scramjets, and single-stage-to-orbit vehicles with scramjets. With Saenger and HOTOL, only the first two concepts are currently under study in Europe. Little work is being devoted to scramjets which will be used for propelling the U.S. National Aero-Spaceplane. The need for an in depth assessment of this third concept is stressed if a realistic comparison is to be carried out. Diagrams of the different propulsion systems are presented. ESA

N90-16803# British Aerospace Public Ltd. Co., Stevenage (England). Space Systems Group.
COST OPTIMISATION OF REUSABLE AEROSPACEPLANE TRANSPORTATION SYSTEMS **c05**
Robert C. Parkinson *In* ESA, Progress in Space Transportation Aug. 1989 p 163-16 (For primary document see N90-16782 09-16)
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A detailed parametric cost model for vehicle development, production and operations, designed for the HOTOL project, is described. The use of this model in comparing different engineering solutions is outlined. Vehicle reliability and abort strategies are integral parts of the model. The high development costs of recoverable vehicles are included in the overall equation. Using this operational costs model, the attractiveness of a single-stage-to-orbit vehicle using an integrated airbreathing and rocket propulsion system is demonstrated. ESA

N90-16804*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
SPACE SHUTTLE SOLID ROCKET BOOSTER REDESIGN AND TESTING **c20**

R. E. Mitchell *In* ESA, Progress in Space Transportation Aug. 1989 p 173-18 (For primary document see N90-16782 09-16)
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The redesigned solid rocket motor of the Space Shuttle is described. Improvements over the model that led to the loss of the Space Shuttle Challenger are outlined. Scale and full-size tests carried out to verify the quality of the redesign are described. A unique feature of the test program is the introduction of deliberate flaws into some test articles. Post-flight evaluation of the redesigned boosters show excellent results. ESA

N90-16805# Glavkosmos, Moscow (USSR).
TRANSPORTATION SYSTEMS FOR MANNED SPACE MISSIONS
Yu P. Semyenov *In* ESA, Progress in Space Transportation Aug. 1989 p 187-18 (For primary document see N90-16782 09-16)
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The main types of transportation systems used for manned space missions are reviewed. Analysis of possible integrated approaches to multipurpose booster utilizations is presented. Combinations with other propulsion systems during the course of a manned space mission launch are described. The solutions being considered by the Soviet manned space missions program are outlined. ESA

N90-16806# Glavkosmos, Moscow (USSR).
U.S.S.R. SPACE TRANSPORTATION SYSTEMS
Boris I. Gubanov *In* ESA, Progress in Space Transportation Aug. 1989 p 191-19 (For primary document see N90-16782 09-16)
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A number of USSR launch vehicles providing launches of spacecraft between one and twenty tons are presented. A new heavy-lift versatile rocket space transportation system called Energia is described. The characteristics of these launch vehicles, and their operational modes and lifting capacity are described. Trends in the development of Energia are considered, including development of fully reusable launch vehicles. ESA

N90-16807# National Space Development Agency, Tokyo (Japan).
DEVELOPMENT STATUS OF JAPAN'S NEW LAUNCH VEHICLE: H-2 ROCKET **c15**
M. Miyazawa, Y. Shibato, and Y. Fukushima *In* ESA, Progress in Space Transportation Aug. 1989 p 197-20 (For primary document see N90-16782 09-16)
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The status of design and development of the H-2 launch vehicle is described. Diagrams and specifications of the launcher are provided. The timetable for the developmental program is presented. The first and second stages are described and shown in diagram form. Different payload fairing diagrams are shown. Launch facilities and launch operations are described. The first test flight of the H-2 launcher is due for 1992. ESA

N90-16808# Centre National d'Etudes Spatiales, Paris (France).
THE ARIANE-5 PROGRAMME **c15**
Andre VanGaver *In* ESA, Progress in Space Transportation Aug. 1989 p 203-20 (For primary document see N90-16782 09-16)
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The Ariane 5 program objectives, organization and funding are outlined. The developmental status of the program is described. The main cryogenic stage development stages are summarized. The elements of the upper composite are described. The Ariane 5 launch site ELA-3 in French Guiana is described. The solid booster test stand and the solid propellant plant are described. ESA

N90-16809# Messerschmitt-Boelkow-Blohm/Entwicklungspring Nord, Bremen (Germany, F.R.).
ARIANE-5 UPPER STAGE EPS **c15**
Horst Holsten and Juergen Kollien *In* ESA, Progress in Space Transportation Aug. 1989 p 207-21 (For primary document see N90-16782 09-16)
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The requirements, present configuration, and potential future applications of the Ariane 5 upper stage (EPS) are described. The main characteristics of this upper stage are as follows: four tanks storing 7200 kg of N2O4/MMH propellant, and a 27.5 KN engine allowing for multiple reignition equipped with a retroburn for deorbitation/reentry. The adaptability of the EPS concept for future use within the ATV (Ariane Transfer Vehicle) and Hermes programs is outlined. ESA

N90-16810# Societe Europeenne de Propulsion, Vernon (France).
VULCAIN ENGINE DEVELOPMENT STATUS **c20**
Dominique Thevenot, E. Kirner, and D. Thelemann (Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn, Germany, F.R.) *In* ESA, Progress in Space Transportation Aug. 1989 p 215-22 (For primary document see N90-16782 09-16)
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The development stages of Vulcain, the cryotecnic main engine of Ariane 5 are described. Tests of the four main subsystems, gas generator, LOX turbopump, LH2 turbobump, and thrust chamber are described. Results of these tests and the activities leading to the first engine test scheduled for mid 1990 are presented. ESA

N90-16811# Centre National d'Etudes Spatiales, Paris (France).
ARIANE-5 SOLID BOOSTERS STAGE DEVELOPMENT **c20**
J. P. Ledey and Alain Coutrot (Europropulsion, Suresnes, France) *In* ESA, Progress in Space Transportation Aug. 1989 p 223-23 (For primary document see N90-16782 09-16)
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Development of the solid booster stage part of the composite lower stage of the Ariane 5 launcher is described. These boosters will be built partly in Europe and partly in French Guiana where both central and aft segments are loaded. Performance tests carried out at different developmental stages are described. Results of these tests are presented. Sealing systems, thermal insulation techniques, nozzle data, and attachment systems are described and diagrams included. A development schedule for booster development is shown. ESA

N90-16812# Centre d'Achevement et d'Essai des Propulseurs et Engins, Saint-Medard-en-Jalles (France).
STATIC TEST DEFLECTOR FOR ARIANE-5 SRM: TECHNICAL DESIGN AND ECONOMICAL CHOICE **c20**
J. Sauvel *In* ESA, Progress in Space Transportation Aug. 1989 p 233-24 (For primary document see N90-16782 09-16)
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Thermal protection systems for the nozzle-down test bay for Ariane-5 solid rocket motors is described. Two solutions are selected: a dry ablative deflector, and a water cooled system with or without expensive coating. Subscale tests carried out with six ton motors indicate that a dry ablative deflector of granite or concrete meets the requirements of low cost, reliability, and simplicity. ESA

N90-16813# Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France).
A METHODOLOGY FOR THE CONCEPT DEFINITION OF ADVANCED SPACE TRANSPORTATION SYSTEMS
Michel Rigault *In* ESA, Progress in Space Transportation Aug. 1989 p 249-25 (For primary document see N90-16782 09-16)
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A methodology for developing a database for an advanced space transportation system is outlined. The lack of existing hard data in this area is compensated for by taking relatively small steps in defining the baseline concepts extrapolated from data obtained from the X-30 and demonstration engines. A technique for further analysis and improvement, starting from this baseline,

is outlined. The goal of the definition system is to allow general technological choices to be made without expensive experimentation. ESA

N90-16814# British Aerospace Public Ltd. Co., Preston (England). Military Aircraft Div.
AERODYNAMIC AND STRUCTURAL DESIGN CHALLENGES OF A REUSABLE SINGLE STAGE TO ORBIT AIR-BREATHING LAUNCH VEHICLE **c15**
Brian R. A. Burns *In* ESA, Progress in Space Transportation Aug. 1989 p 255-26 (For primary document see N90-16782 09-16)
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The need for a new advanced space transport early in the next century is outlined. The advantages of single stage to orbit systems are discussed. Design sensitivity problems are noted. Problems of pitch control and their solution are described. The design of each major component of HOTOL is outlined, covering aerodynamic, structure, materials and systems aspects. A successful simulation of autoland in a variety of wind conditions is summarized. ESA

N90-16815# Stuttgart Univ. (Germany, F.R.). Inst. fuer Raumfahrtsysteme.
MISSION-DEPENDENT SELECTION OF PROPULSION SYSTEMS FOR REUSABLE LAUNCH VEHICLES **c20**
Ulrich M. Schoettle *In* ESA, Progress in Space Transportation Aug. 1989 p 261-26 (For primary document see N90-16782 09-16)
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Ascent performance of air breathing propulsion concepts for possible two-stage and single-stage launch vehicles are discussed. Advanced LOX/LHZ rockets and airbreathing concepts such as rocket-turborocket-ramjet, turborocket-ramjet and rocket-ramjet systems are considered. Depending on the mission specifications, either the rocket-turborocket-ramjet or the rocket-ramjet variant are concluded to be the leading candidates for horizontal takeoff single-stage vehicle propulsion. The turbo-rocket-ramjet variant is the preferred system for stage one propulsion of two-stage vehicle concepts. ESA

N90-16816# Technische Univ., Munich (Germany, F.R.).
OPTIMUM ASCENT PERFORMANCE OF WINGED TWO-STAGE VEHICLES
G. Sachs, Robert Bayer, and Johannes Drexler *In* ESA, Progress in Space Transportation Aug. 1989 p 271-27 (For primary document see N90-16782 09-16)
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The key factors involved in the ascent performance of the upper stage of a two stage space transportation system are presented. Performance enhancement due to lifting capability is given particular attention. A separation flight maneuver is investigated. It is shown that constraints (dynamic pressure and load factor limits) have a significant effect on the ascent performance. Two optimization methods are presented. One is an indirect technique applying the minimum principle and the multiple shooting method. The other represents a direct technique where the control vector function is paremeterized. ESA

N90-16817# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Corbeil (France).
PROGRESS IN AIRBREATHING COMBINED ENGINES FOR FUTURE EUROPEAN LAUNCHER **c07**
Michel Doublier, P. Ramette, and D. Scherrer (Office National d'Etudes et de Recherches Aerospatiales, Paris, France) *In* ESA, Progress in Space Transportation Aug. 1989 p 279-28 (For primary document see N90-16782 09-16)
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An overview of research in the area of combined engine cycles is presented. The usefulness of such air breathing engines in developing a hypersonic winged launcher is outlined. Information on turbo-rocket, rocket-ramjet and turbofan-ramjet rocket systems is presented. Engine/vehicle integration problems are addressed, and critical technology areas are identified. It is concluded that the best engine system choice cannot yet be made. The technology needed for a successful airbreathing combined engine launcher will require a ten year period for development. ESA

N90-16818# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.).
SAENGER PROPULSION SYSTEM OPTIONS **c07**
Norbert Voss and Martin Albers (Motoren- und Turbinen-Union Muenchen G.m.b.H., Germany, F.R.) *In* ESA, Progress in Space Transportation Aug. 1989 p 287-29 (For primary document see N90-16782 09-16)
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A general survey of concept definition and performance characteristics involved in choosing a propulsion system for the Saenger launcher is presented. Initial concept studies considered a parallel turbojet-ramjet system for the first stage. Alternative concepts such as tandem-turbo-ramjet, with and without intercooling, and a turboexpander-ramjet with and without precombustion are investigated. Engine integration and propulsion system size, dependent on engine configuration, are discussed. A survey of currently available and future required test facilities is presented. ESA

N90-16819# Rolls-Royce Ltd., Bristol (England).
PARAMETRIC ASSESSMENT OF PROPULSION SYSTEM MASS FOR AIRBREATHING LAUNCHER CONFIGURATIONS **c07**
F. A. Hewitt and Rainer R. Schwab *In* ESA, Progress in Space Transportation Aug. 1989 p 293-29 Sponsored in part by ESA (For primary document see N90-16782 09-16)
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Sensitivity of power plant mass to such variables as vehicle thrust requirements, precompression surface incidence, intake and nozzle designs and turbomachinery design constraints is described. A turboramjet power plant propelling the first stage of a two-stage-to-orbit launcher is studied. The engine is behind a rectangular ramp intake with the reheat system operating as a ramjet burner for flight beyond Mach 3. Aspects of overall vehicle performance are described and the influence of mission definition on power plant optimization is discussed. ESA

N90-16820# British Aerospace Public Ltd. Co., Preston (England). Military Aircraft Div.
PERFORMANCE INTEGRATION OF A REUSABLE LAUNCH VEHICLE WITH HYBRID AIRBREATHING ROCKET PROPULSION **c20**
Steve G. Furniss and I. M. Walters (British Aerospace Dynamics Group, Stevenage, England) *In* ESA, Progress in Space Transportation Aug. 1989 p 299-30 (For primary document see N90-16782 09-16)
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The interactive process of designing a single-stage-to-orbit vehicle is discussed. The need for a total system model in order to conduct necessary trade-off studies is stressed. Trade-offs involving fuselage shape and design and their influence on drag and structural efficiency are discussed. Rocket and air-breathing propulsion modes are discussed. The air-breathing ascent, rocket ascent and re-entry trajectories stages of a mission are assessed. The requirements for optimum performance in each of these portions of the mission are described and their influence on the overall vehicle design is outlined. ESA

N90-16821# European Space Agency. Centre Spatial de Toulouse (France).
THE HERMES SYSTEM: ITS DESIGN OBJECTIVES AND SOLUTIONS
J. J. Capart and Michel Courtois (Centre National d'Etudes Spatiales, Toulouse, France) *In its* Progress in Space Transportation Aug. 1989 p 311-318 (For primary document see N90-16782 09-16)
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The status of the Hermes spaceplane system is reviewed. The main mission and system requirements and their translation into

design constraints are presented. The design compromises made in order to obtain optimum overall solutions are identified. Payload accommodation, in-orbit handling and internal and external servicing are discussed. The parameters affecting manned safety and life accommodation are analyzed. Overall operational requirements, maintainability and logistic considerations, and the resulting requirements placed on the launch and ground control segment are discussed. ESA

N90-16822# Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France).
AERONAUTICAL ASPECTS OF HERMES RE-ENTRY: QUESTION MARKS AND PROSPECTS
Philippe Amblard *In* ESA, Progress in Space Transportation Aug. 1989 p 319-32 (For primary document see N90-16782 09-16)
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Problems raised by Hermes reentry are discussed. As it is smaller than the Space Shuttle or Buran and has a different shape, no technological or scientific background exists for many parameters. The need for developing new technologies, particularly in the fields of aerodynamics, aerothermodynamics and hot temperature materials is stressed. The research and development programs established to tackle this challenge are described. Special test facilities under development are described. The importance of the Hermes program as a stepping stone for further European space projects is summarized. ESA

N90-16823# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Space Systems Group.
HERMES PROPULSION SYSTEM **c20**
Jochen Hofmann, H. Bassewitz, Vittorio Bombelli, G. Schmidt, and G. Morio (Aerospatiale, Les Mureaux, France) *In* ESA, Progress in Space Transportation Aug. 1989 p 323-33 (For primary document see N90-16782 09-16)
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The Hermes propulsion system and its architecture are described. Special attention is given to safety requirements for manned missions, part reusability and reentry survival. It is shown that the design capability and hardware experience is available in Europe for developing the Hermes bipropellant propulsion system. A schedule of updates and refinements on the propulsion system is obtained. ESA

N90-16824# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.).
OVERVIEW OF THE HERMES IN-ORBIT CONTROL SYSTEM
Eveline Gottzein, Klaus Janschek, and Wilfried Oesterlin *In* ESA, Progress in Space Transportation Aug. 1989 p 333-34 (For primary document see N90-16782 09-16)
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An overview of the Hermes spaceplane orbital flight control system is presented. System aspects, spaceplane configuration and guidance-navigation-control related mission aspects are outlined. The orbital flight controller functional and operational architecture is presented with special emphasis on hierarchical and modular design aspects. The key issues of the orbital flight controller development life cycle, ranging from design and analysis through test and verification, are discussed. ESA

N90-16825# Aerospatiale, Blagnac (France).
HERMES SPACE VEHICLE: SAFETY CONSIDERATIONS
Gerard Borycki *In* ESA, Progress in Space Transportation Aug. 1989 p 345-35 (For primary document see N90-16782 09-16)
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Crew safety considerations and their application and implementation in the Hermes concept are reviewed. On the basis of the current configuration, risk assessments are given and the main safety critical points are identified. Safeguard possibilities and some considerations about program management and organization are presented. ESA

N90-16826# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
HERMES GROUND OPERATION CONCEPTS **c14**
Fritz Gampe and Pierre Letalle (MATRA Espace, Toulouse, France) *In its* Progress in Space Transportation Aug. 1989 p 351-356 (For primary document see N90-16782 09-16)
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The Hermes ground operations, from touch-down to the following launch are described. The steps required to make the complete spaceplane vehicle ready for flight again are outlined. The accommodation of new cargo is described. The ground operations concept is designed to handle sixty flights by two spaceplanes over a series of fifteen years. Its missions include flights to the Columbus Free-Flying Laboratory, the Freedom Space Station (FSS), and crew rescue missions to the FSS. ESA

N90-16827# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.).
HERMES TRAINING AIRCRAFT
Dietrich Hanke and Genene Gargir (Centre National d'Etudes Spatiales, Toulouse, France) *In* ESA, Progress in Space Transportation Aug. 1989 p 357-36 (For primary document see N90-16782 09-16)
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The Hermes Training Aircraft (HTA) flight simulator is described. It is designed to train Hermes pilots and crew for the steep, unpowered landing approach trajectory. The HTA is able to simulate approach trajectories from an altitude of 37,000 ft. to touchdown under real environmental conditions. Based on the training mission requirements, the simulation concept design, simulation equipment and host aircraft modifications are presented. ESA

N90-16828# Aerospatiale, Les Mureaux (France).
OPERATIONAL DRIVERS FOR LAUNCHER ARCHITECTURES **c15**
Henri Lacaze *In* ESA, Progress in Space Transportation Aug. 1989 p 367-37 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

Requirements beyond payload mass and launch cost encountered in designing, flight rating, and using the first generation of European launchers are identified. The impact of these requirements on the architectural choices to be made for the next generation of space launchers is discussed. This inventory is not intended as a selection process for preferred concepts, but yields criteria to which various proposals can be compared. ESA

N90-16829*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
US SPACE SHUTTLE EVOLUTION
Charles Teixeira *In* ESA, Progress in Space Transportation Aug. 1989 p 373-38 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03 CSCL 22B

The long term systematic series of upgrades and enhancements needed to insure that the Space Shuttle remains a viable, cost-effective transportation system are discussed. A candidate Space Shuttle evolution strategy is presented. It emphasizes enhanced reliability, crew safety, reduced operations costs and enhanced capabilities required to meet projected long-range requirements. The strategy includes definition of long-term goals and requirements, potential hardware and operation enhancements, and addresses the issues of fleet size and utilization. ESA

N90-16830*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
SHUTTLE C: HEAVY-LIFT VEHICLE OF THE 1990'S **c15**
Thomas J. Lee *In* ESA, Progress in Space Transportation Aug. 1989 p 383-39 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03 CSCL 22B

The unmanned, Shuttle-C, a low cost evolution of the U.S. Space Shuttle is described. It is capable of delivering 45,400 to 77,100 kg payloads by 1994. The Shuttle-C's design is evolved

directly from the Space Shuttle. The payload carrier, the only new element of the Shuttle-C, is a cylindrical payload bay 4.6 m in diameter by 25 m in length. Diagrams of similarities and differences betwen the Shuttle and Shuttle-C are presented. A typical mission profile is illustrated. Payload carrying abilities and other applications are described. ESA

N90-16831# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
VIEWS ON THE EVOLUTION OF EUROPEAN SPACE TRANSPORT: THE REFERENCE LAUNCHER CONCEPT EARL 2
Wolfgang Westphal, Karl-Wilhelm Kalk, and Gottfried Greger (Bundesministerium fuer Forschung und Technologie, Bonn, Germany, F.R.) *In* ESA, Progress in Space Transportation Aug. 1989 p 391-39 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

The joint Department of Defense (DOD)/NASA Advanced Launch System (ALS) program is described. The ALS is cost rather than performance optimized. It will use advanced technology and innovative management and design approaches to achieve a congressionally mandated cost goal of $300 per pound to low-earth orbit by the year 2005. The space system acquisition approach is described. The influence of acquisition and technological innovations on other U.S. space transportation, programs such as commercial programs and the National Aero-Space Plane, is discussed. Diagrams of possible launch configurations are presented. ESA

N90-16832*# Aerospace Corp., Los Angeles, CA.
THE JOINT DOD/NASA ADVANCED LAUNCH SYSTEM (ALS) PROGRAMME **c15**
M. G. Wolfe *In* ESA, Progress in Space Transportation Aug. 1989 p 397-40 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03 CSCL 22B

The Earl 2 reusable space launcher is described. It is predicted that by 2005, the flight rate capacity, and thus the economical operation, of the expendable Ariane 5 will be improved upon by a reusable concept of the same payload class. The Earl 2 is also designed to accommodate a wider variety of missions. It is foreseen that missions such as crew transport, servicing, maintenance, and repair, emergency operations and the delivery of bulky infrastructure sub-assemblies, as well as single satellites, must be taken into account. The Earl 2 concept is seen as a logical bridging piece for technological evolution up to Saenger-class systems. Diagrams and development timetables for the Earl 2 are presented. ESA

N90-16833*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
THE LIQUID ROCKET BOOSTER AND ITS POTENTIAL FOR THE STS **c20**
Paul H. Bialla (General Dynamics Corp., San Diego, CA.) and J. E. Hughes *In* ESA, Progress in Space Transportation Aug. 1989 p 405-41 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03 CSCL 21H

Results of the liquid rocket booster study initiated by NASA to define an alternative to solid rocket boosters, are presented. The prime study contractors, Martin Marietta Corporation and General Dynamics, have identified liquid rocket booster configurations that can increase shuttle performance to 70 klb. These boosters will provide improved reliability, hold down, verification prior to vehicle release, engine-out and abort capabilities. Phasing of these boosters into Space Transportation System (STS) operations without adversely affecting flight rate is described. ESA

N90-16834# General Dynamics Corp., San Diego, CA.
ARE REUSABLE BOOSTERS COST-EFFECTIVE **c20**
Daniel A. Heald *In* ESA, Progress in Space Transportation Aug. 1989 p 411-41 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

The cost parameters of using reusable boosters on such future launch vehicle programs as the Advanced Launch System (ALS) and Liquid Rocket Booster (LRB) for the shuttle are discussed. Technical and cost issues are analyzed. Data is presented on recovery systems and refurbishing efforts. Some uncertainties are identified. Minimal data on refurbishing liquid rockets is presently available. Data on solid rocket boosters, however, indicate substantial cost savings due to reuse. General Dynamics will demonstrate reusability of an Atlas booster engine system to provide specific data on cost-effectiveness. ESA

N90-16835# National Space Development Agency, Tokyo (Japan).
HOPE: ITS CONCEPT AND TECHNICAL FEATURES
Tetsuichi Ito *In* ESA, Progress in Space Transportation Aug. 1989 p 417-42 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

The aerodynamics, thermal structures, and guidance and control subsystems of the H-2 Orbiting Plane (HOPE) are presented. The size of HOPE is restricted by the compatibility with the H-2 rocket at launch and allowable wing at return. Parameters involved in vehicle shape selection are described. These involve flight performance considerations through a wide speed range and possible space station interfacing. The use of a combination carbon fiber/polyamide as the primary structural material is described. Control algorithms and instrument specifications involved in developing the guidance and control subsystems are described. ESA

N90-16836# Societe Europeenne de Propulsion, Saint-Medard-en-Jalles (France).
MATERIAL TECHNOLOGY CHALLENGES IN SPACE TRANSPORTATION
Didier G. Desnoyer *In* ESA, Progress in Space Transportation Aug. 1989 p 429-43 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

The factors and requirements guiding material technology for space applications are described. The increasingly wide range of flight characteristics, namely manned or unmanned flight, mission duration, cyclic missions, and atmospheric composition, place different requirements on the materials used. Various high temperature materials are compared. Composite materials (C/C, C/SiC, SiC/SiC) and refractory alloys are compared in terms of mechanical and chemical properties. Their applications in the Hermes and Cassini programs are discussed. Their influence on design is shown. Cost evaluations are provided. ESA

N90-16837# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.).
NEW MATERIALS AND STRUCTURAL CONCEPTS FOR SPACE TRANSPORTATION SYSTEMS
H. W. Bergmann, Wolfgang Bunk, and G. Grueninger *In* ESA, Progress in Space Transportation Aug. 1989 p 439-44 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

The characteristics of metal and composite materials used in space transportation systems are discussed. Manufacturing aspects and design concepts are outlined. Emphasis is placed on passively cooled airframe components, cryogenic tanks and propulsion components. Polymer matrix composites, metal matrix composites, glass matrix composites, ceramic matrix composites, and carbon/carbon composites are each considered in turn. ESA

N90-16838# Technische Univ., Berlin (Germany, F.R.).
PROPELLANT TRENDS IN ADVANCED ROCKET PROPULSION **c20**
Roger E. Lo and Michael Thierschmann *In* ESA, Progress in Space Transportation Aug. 1989 p 449-46 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

Propellant choice considerations for future high performance rocket motors are reviewed. Dual fuel engines with liquid oxygen as oxidizer and hydrogen and high density hydrocarbons as fuel

are discussed. Dual mixture ratio engines are discussed as another type of mixed mode propulsion. The properties and performances of dual mode and high energy systems based on fluorine as oxidizer and/or using metal combustion are reviewed. Possible superhigh energy propellants to be developed in the future are discussed. These involve different solutions for using atomic hydrogen as a propellant. Extensive research is needed before such a fuel could be used. ESA

N90-16839# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.).

COAXIAL INJECTION TECHNOLOGY FOR HYPERGOLIC PROPELLANTS **c20**

G. Schmidt, Guenter Langel, and Helmut Zewen *In* ESA, Progress in Space Transportation Aug. 1989 p 461-46 (For primary document see N90-16782 09-16)

Copyright Avail: NTIS HC A22/MF A03

A comparison of impinging and coaxial injector techniques is presented. The development strategy and actual development status of the coaxial injector type for hypergolic, storable, propellants are outlined. Emphasis is placed upon the test results of this injector type in terms of combustion efficiency and stability. Injection technology as a key element for future European engines with storable propellants and thrust above 1 KN is discussed. ESA

N90-16840# Societe Europeenne de Propulsion, Vernon (France).

HIGH-PERFORMANCE LO2-CH4 ENGINE WITH CERAMIC MATRIX COMPOSITE MATERIALS **c27**

Andre Beaurain and C. Bonniot *In* ESA, Progress in Space Transportation Aug. 1989 p 469-47 (For primary document see N90-16782 09-16)

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Research on an LO2-CH4 engine with a 2000 KN vacuum thrust is described. The engine uses a simple gas generator cycle with turbine series. The extensive use of thermostructural composite materials is outlined. These materials allow for a significant decrease in engine mass while specific impulse response is improved through an increase in the inlet temperature of the turbines. ESA

N90-16841# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Stuttgart (Germany, F.R.).

THE DLR TECHNOLOGY PROGRAMME ON SPACE TRANSPORTATION

Martin Mailaender and C.-J. Winter *In* ESA, Progress in Space Transportation Aug. 1989 p 479-48 (For primary document see N90-16782 09-16)

Copyright Avail: NTIS HC A22/MF A03

Three DLR (German Aerospace Research Establishment) programs related to the Hermes project, the Saenger project, and the Columbus and Ariane projects, are described. Selected examples of recent achievements and plans for future research in these three projects are presented. Relations with national and international partners are outlined. Various aspects of participation in current programs and the development of future technologies are discussed. ESA

N90-16842# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.).

VERIFICATION OF AEROTHERMODYNAMIC CODES BY MEANS OF A WINGED EXPERIMENTAL RE-ENTRY VEHICLE

Ernest Henrich Hirschel and H. Grallert *In* ESA, Progress in Space Transportation Aug. 1989 p 485-50 Sponsored in part by Avions Marcel Dassault-Breguet Aviation (For primary document see N90-16782 09-16)

(Contract ESA-H-ST-13-01-AS)

Copyright Avail: NTIS HC A22/MF A03

A verification database used in establishing methods of computational aerothermodynamics is described. These computational methods are intended to assist classical aerothermodynamic design tools such as wind tunnels. It is shown that wind tunnels cannot completely yield the data base needed. An experimental winged reentry vehicle is needed for this purpose. The potential database derived from such an experimental vehicle is discussed. Data from a reentry capsule is analyzed. A four-loop approach for the validation of the numerical codes is suggested. The database from the experimental vehicle is used as the final decisive database. The special needs of atmospheric hypersonic airplanes are discussed. ESA

N90-16843# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.).

AERODYNAMIC SIMULATION CONDITIONS IN ARC HEATED WIND TUNNELS **c09**

Knut Kindler *In* ESA, Progress in Space Transportation Aug. 1989 p 501-50 (For primary document see N90-16782 09-16)

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The use of arc heated wind tunnels to study the special thermodynamic conditions created near space vehicles at high flight velocities is described. Simulation conditions of equilibrium flow are not sufficient. The characteristic times for dissociation and recombination become important for definition of test conditions. It is concluded that arc heated wind tunnels are the best tools presently available for realistic material research. The difference between flight and wind tunnel flow is described. Available test conditions are shown in relation to flight conditions of the Hermes space shuttle. ESA

N90-16844# European Space Agency. European Space Operations Center, Darmstadt (Germany, F.R.).

EFFICIENT CALCULATION OF ARIANE ASCENT TRAJECTORIES WITH RECURSIVE QUADRATIC PROGRAMMING **c61**

W. Flury and M. Hechler *In its* Progress in Space Transportation Aug. 1989 p 509-517 (For primary document see N90-16782 09-16)

Copyright Avail: NTIS HC A22/MF A03

An approach to rocket trajectory optimization is presented. Methods developed in optimal control (Pontryagin's maximum principle) and parameter optimization are described. The method involves the optimization of a set of discrete parameters. Their optimum values with regard to maximum mass in orbit subject to constraints are determined with a recursive quadratic programming algorithm. The method has been used extensively for Ariane performance and trajectory analysis for terrestrial satellite missions and interplanetary probes. The complete spectrum of target orbits is addressed and examples are shown for Ariane 4 and 5. ESA

N90-16845# Commission of the European Communities, Brussels (Belgium).

THE EUROPEAN SPACE EFFORT: AN INTEGRAL PART OF THE CONSTRUCTION OF EUROPE **c12**

Herbert Josef Allgeier *In* ESA, Progress in Space Transportation Aug. 1989 p 521-52 (For primary document see N90-16782 09-16)

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The importance of the European space program in forging stronger links between European nations is discussed. The importance of space technology in communications is cited. The growing importance of the space industry on a global level is addressed. The importance of getting and maintaining a firm position in the global space industry field is stressed. The potential competitive advantages of a united European space effort are described. ESA

N90-16846*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.

DEBRIS/ICE/TPS ASSESSMENT AND PHOTOGRAPHIC ANALYSIS FOR SHUTTLE MISSION STS-33R

Charles G. Stevenson, Gregory N. Katnik, and Scott A. Higginbotham Dec. 1989 174 p Original contains color illustrations

(NASA-TM-102785; NAS 1.15:102785) Avail: NTIS HC A08/MF A01 CSCL 22B

A debris/ice/Thermal Protection System (TPS) assessment and photographic analysis was conducted for Space Shuttle Mission STS-33R. Debris inspections of the flight elements and launch pad are performed before and after launch. Ice/frost conditions on the external tank are assessed by the use of computer programs, nomographs, and infrared scanner data during cryogenic loading of the vehicle followed by on-pad visual inspection. High speed photography is analyzed after launch to identify ice/debris sources and evaluate potential vehicle damage and/or in-flight anomalies. This report documents the debris/ice/TPS conditions and photographic analysis of Mission STS-33R, and their overall effect on the Space Shuttle Program. Author

17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

No abstracts in this category.

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

N90-16847 Texas Univ., Austin.
TALON AND CRADLE: SYSTEMS FOR THE RESCUE OF TUMBLING SPACECRAFT AND ASTRONAUTS, A PRELIMINARY DESIGN Ph.D. Thesis
Dunning V. Idle 1989 249 p
Avail: Univ. Microfilms Order No. DA8920731

Advanced pressure suit and tool design are beginning to allow extravehicular astronauts to repair space vehicles and so increase mission life and system reliability. A common spacecraft failure that is a severe challenge to the rescue mission planner is loss of attitude control resulting in tumbling motion. If an extravehicular astronaut flying the Manned Maneuvering Unit (MMU) falls into a tumble, the result could be loss of life. TALON (Tumble Arresting Large Oscillation Nullifier) is a device capable of capturing a target in an uncontrolled three-axis tumble. CRADLE (Concentric Rotating Astronaut Detumble Lifesaving Equipment) is a similar device sized to rescue a suited astronaut. The two rescue vehicles work on the same basic principle. They are structural shells with articulated limbs which can surround a tumbling target and thus align both the chaser and target centers of mass (CM). Adjusting chaser limb geometry to match the target principle Inertia Moment Ratios (IMRs) enables the chaser to spin up into a torque free tumble that is identical to that of the target. The target will be motionless in the chaser frame and thus be easily grappled. To automate TALON or CRADLE requires a knowledge of the target attitude, attitude rates, and inertia moment ratios. By observing three non-colinear target surface points, researchers can use standard numerical estimation techniques to derive the target tumble state parameters, as well as the location of the center of mass.
Dissert. Abstr.

N90-16848*# National Aeronautics and Space Administration, Washington, DC.
AN ASSESSMENT OF POTENTIAL MARKETS FOR SMALL SATELLITES
Lawrence H. Stern, Kevin J. Lacobie, and Zenon X. Zygmont (George Mason Univ., Fairfax, VA.) Nov. 1989 114 p
(NASA-TM-101943; NAS 1.15:101943; LC-89-51915; ISBN-0-9625101-0-6) Copyright Avail: NTIS HC A06/MF A01 CSCL 22B

A number of economic and technological issues associated with the dynamic field of small satellite systems and applications are addressed. Current activities are described in the design and development of small satellites, and assesses potential commercial markets for these satellites and their services. The research includes a history of the small satellite industry, current activities of satellite manufacturers, support services for small satellite systems, including launch vehicles and ground control, potential users of small satellites, the availability of various enabling technologies, and other factors which might enable small satellites to be commercially successful. Also addressed are the potential difficulties of small satellite development and production. Based upon an extensive overview of existing literature, and in-depth interviews with the entire breadth of the industry, this study represents up-to-date information regarding this growing area of commercial space activity. Author

N90-16849# Royal Aerospace Establishment, Farnborough (England). Space Dept.
ENVIRONMENTAL CONSTRAINTS FOR POLAR PLATFORM DESIGN
A. J. Sims, P. R. Truscott, G. L. Wrenn, and C. S. Dyer Mar. 1989 28 p Presented at the 38th International Astronautical Federation Congress, Brighton, England, Oct. 1987
(RAE-TR-89014; BR111596; AD-A215300; ETN-90-96139) Copyright Avail: NTIS HC A03/MF A01

Factors relevant to the polar platform are reviewed. Environment models and radiation transport codes are employed to assess primary and secondary particle fluxes, dose rates and energy loss spectra. Monitors which can improve the database, are described. The size increase of future polar platforms compared with current spacecraft shows the need for further investigation and modeling of the deleterious influences of charging and plasma wake phenomena. A need for further modeling of the environment and its effects in conjunction with environment measurements and both in-orbit and ground based characterization of key technologies is demonstrated. ESA

N90-16850# Oak Ridge National Lab., TN. Engineering Physics and Mathematics Div.
NUCLEAR WEAPON RADIATION EFFECTS ON A SPACE BASED INTERCEPTOR WEAPON PLATFORM
J. O. Johnson, M. S. Smith, and R. T. Santoro 1990 5 p Presented at the HEART Conference, Monterey, CA, 12-16 Feb. 1990 Sponsored in part by AFWL
(Contract DE-AC05-84OR-21400)
(DE89-016258; CONF-900216-3) Avail: NTIS HC A01/MF A01

The purpose was to determine the dose to the various electronic components and sensitive areas (fuel tanks) of a representative Space Based Interceptor (SBI) weapon platform due to an exo-atmospheric nuclear weapon detonation. In particular, the damage resulting from incident neutrons, gamma-rays, and x rays generated by the weapon detonation was assessed for the critical electronic components and for materials whose chemical/physical properties might degrade. To perform this analysis, a three dimensional ORNL computer model of a SBI weapon platform was devised to estimate the effects of natural and nuclear weapon radiation on the external surfaces and materials and on the internal components. It should be noted that the SBI weapon platform used represents the author's concept of such a system. DOE

N90-16851*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Aerospace and Ocean Engineering.
SCREENING ACTUATOR LOCATIONS FOR STATIC SHAPE CONTROL Progress Report, 1989
Raphael T. Haftka Jan. 1990 19 p
(Grant NAG1-224)
(NASA-CR-181970; NAS 1.26:181970) Avail: NTIS HC A03/MF A01 CSCL 22B

Correction of shape distortion due to zero-mean normally distributed errors in structural sizes which are random variables is examined. A bound on the maximum improvement in the expected value of the root-mean-square shape error is obtained. The shape correction associated with the optimal actuators is also characterized. An actuator effectiveness index is developed and shown to be helpful in screening actuator locations in the structure. The results are specialized to a simple form for truss structures composed of nominally identical members. The bound and effectiveness index are tested on a 55-m radiometer antenna truss structure. It is found that previously obtained results for optimum actuators had a performance close to the bound obtained here. Furthermore, the actuators associated with the optimum design are shown to have high effectiveness indices. Since only a small fraction of truss elements tend to have high effectiveness indices, the proposed screening procedure can greatly reduce the number of truss members that need to be considered as actuator sites.
Author

N90-16852*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SPACECRAFT ENVIRONMENTAL ANOMALIES HANDBOOK Final Report, Oct. 1987 - Aug. 1989
Paul A. Robinson, Jr. 1 Aug. 1989 282 p
(Contract NAS7-918; AF Proj. 2822)
(NASA-CR-186331; NAS 1.26:186331; AD-A214603; GL-TR-89-0222) Avail: NTIS HC A13/MF A02 CSCL 22/2

Anomalies on spacecraft can be avoided by understanding their mechanisms and causes. This handbook discusses single event upsets (SEUs), surface charging and discharging, and internal or deep dielectric charging along with methods available for the reduction or elimination of the effects they can cause in spacecraft.
GRA

N90-16853# Iowa State Univ. of Science and Technology, Ames. Dept. of Mechanical Engineering.
INVESTIGATION OF LIQUID SLOSHING IN SPIN-STABILIZED SATELLITES Final Technical Report, 1 Jan. 1986 - 31 Aug. 1989
Joseph R. Baumgarten, Donald R. Flugrad, and Joseph M. Prusa 31 Aug. 1989 287 p
(Grant AF-AFOSR-0080-86; AF Proj. 2302)
(AD-A214730; ISU-ERI-AMES-90401; AFOSR-89-1312TR) Avail: NTIS HC A13/MF A02 CSCL 22/3

Launching of several Star 48 communications satellites from the space shuttle has consistently resulted in a nutating of the spacecraft. Sloshing fluid stores were suspected as the source of this dynamic instability. A mathematical model of the sloshing fluid motion coupled with the satellite dynamics was developed and the launch phase simulated. The flight simulation shows similar behavior when compared to the telemetered flight data. Additionally, a control law was developed using an equivalent mechanical model of the fluid motion which results in a stable dynamic system. The control law may also be used for pointing maneuvers and is implemented by sensing only the main body angular rates and attitude. An experimental satellite-simulator test rig was designed and built to study the interaction of the sloshing fluid and spinning structure. The test rig was instrumented to monitor the motion of several rotating configurations. A mathematical model of the simulator was developed and is presented. Simulation of experimental results has been achieved. The computational fluid dynamic analysis has now developed a primitive variables numerical algorithm for a two-dimensional and three-dimensional sloshing problem. The key feature of the formulation is use of a coordinate transformation that maps the fluid body into the fixed geometric shape of the containing rectangle or sphere.
GRA

N90-16854# Massachusetts Inst. of Tech., Cambridge.
FEASIBILITY OF MILLIMETER-ACCURACY GEODETIC POSITIONING AND VEHICLE TRACKING WITH REPEATER SATELLITES Scientific Report No. 5, Apr. 1986 - Jul. 1989
Laureano Alberto Cangahuala 27 Jul. 1989 24 p Sponsored in part by NSF
(Contract F19628-86-K-0009; AF Proj. 2309)
(AD-A214755; GL-TR-89-0231; SR-5) Avail: NTIS HC A03/MF A01 CSCL 25/2

The proposed Geobeacon satellite can detect and locate transmitters of a geodetic positioning system as well as transmitters of an emergency search and rescue (SAR) system. Simple, low-power transmitters on the earth's surface will broadcast code-modulated signals which will be received and rebroadcast to a processing site by a constellation of repeater satellites. A SAR transmitter can transmit at one frequency. For geodetic applications, a transmitter must transmit signals at more than one frequency, including a relatively low (e.g., 100 MHz) and a relatively high (several GHz) frequency. The LF signals would aid acquisition and tracking of the higher frequency signals. By virtue of this aiding, the transmitted power required to enable tracking of signals at 10 GHz is about 100 times less than the power needed for tracking such a signal alone. Uplink power requirements both for aided tracking and for unaided acquisition are calculated as functions of frequency from 100 MHz to 50 GHz. The chief uncertainty in the calculations concerns the man-made radio noise environment in earth orbit. An algorithm is developed to select frequencies by which aided tracking of the highest frequency signal can be maintained. This algorithm is based on a stochastic description of the kinematic and ionospheric contributions to the received signal frequencies and phases. Discrete Kalman filter equations are derived for estimating the covariance of phase and frequency estimates.
GRA

N90-16855# Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
DELTA 181 SENSOR MODULE COMMAND CENTER
R. J. Heins, A. A. Chacos, and M. J. Hermes Sep. 1989 33 p
(Contract N00039-89-C-5301)
(AD-A214868; JHU/APL-TG-1374) Avail: NTIS HC A03/MF A01 CSCL 22/2

An APL-designed sensor module was launched into orbit and performed a number of significant SDI Delta 181 program experiments. Sensor module on-orbit command and control operations involved a network of worldwide facilities called the control complex. A major component was the sensor module command center, which was designed, installed, and operated by APL. This document presents an overview of command center system design. Particular emphasis is given to the hardware design and interface to worldwide assets. Pertinent detail of the Delta 181 control complex and command center mission operations is given to place the design in overall context. The command center design is described within the context of the Delta 181 mission. After completion of the Delta 181 mission, a modified version of the command center was used to successfully support the Delta Star mission in March 1989. Mission control center and network design concepts developed for these programs is being over to ongoing development of similar applications.
GRA

N90-16856# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.
RADIATION OF PLASMA WAVES FROM LARGE SPACE STRUCTURES IN LOW EARTH ORBIT Final Report, 30 Jun. 1986 - 31 Aug. 1988
D. E. Hastings, A. Barnett, and S. Olbert 5 Oct. 1988 39 p Repr. from Journal of Geophysical Research, v. 93, no. A3, 1 Mar. 1988 p 1945-1960
(Contract F19628-86-K-0027)
(AD-A215062; AFGL-TR-88-0276) Avail: NTIS HC A03/MF A01

There are many situations of interest in space and astrophysics which consist of a conducting body moving across a magnetized plasma. It is well known that large conducting objects which move slowly across mangetic field lines radiate low frequency (Alfven) waves. The interaction between a plasma and a moving conductor is studied to estimate the total power radiated at all frequencies. Toward this end, a formalism which permits the computation of the response of the plasma to an external current source was developed. An integral equation is derived which relates the source current to the electrical properties of the conducting body.

Author

N90-16857# Naval Postgraduate School, Monterey, CA. Dept. of Administrative Sciences.

THE EXTENSION OF TECHNOLOGY AND THE CONTROL OF PRODUCTION COSTS IN ADVANCED SATELLITE SYSTEMS M.S. Thesis

John Charles Scorby, Jr. Jun. 1989 91 p

(AD-A215104) Avail: NTIS HC A05/MF A01 CSCL 05/3

Advances in technology can affect production costs which in turn can be affected by a contractor's financial condition. The purpose of this thesis is to test the relationships between advances in technology, production costs and financial conditions of contractors. The analysis is conducted using data from a sample of satellite systems. This thesis describes the relationships between technology and production cost with the goal of developing a model which can be used for projecting production cost as technology advances. The findings indicate that production cost is significantly associated with measures of technology and with measures of development cost. The relationships identified lay the foundation for projecting production cost. This thesis also examines relationships between control over production cost by contractors and their financial condition. The analysis suggests that aspects of financial condition may be indicators of a contractors ability to control production cost, but data limitations prohibit strong conclusions. GRA

N90-16858# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

SENSITIVITY OF SPACE SYSTEM AVAILABILITY PREDICTIONS TO UNDERLYING COMPONENT RELIABILITY ESTIMATES M.S. Thesis

James R. Wolf Dec. 1989 193 p

(AD-A215535; AFIT/GSO/ENS/89D-17) Avail: NTIS HC A09/MF A02 CSCL 22/5

Space system availability prediction is the process of estimating the likelihood that a space system will be available to perform its assigned mission, as a function of time. The ability to make these predictions accurately is fundamental to the efficient employment of Air Force resources. Availability prediction is based on the estimated reliability of individual spacecraft and the components of which they are comprised. This study made use of response surface methodology to determine the sensitivity of the system availability prediction to the estimated reliabilities of individual spacecraft components. GRA

N90-16859# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

ROBUSTNESS OF A MOVING-BANK MULTIPLE MODEL ADAPTIVE CONTROLLER FOR A LARGE SPACE STRUCTURE M.S. Thesis

Michael R. Schore Dec. 1989 182 p

(AD-A215670; AFIT/GE/ENG/89D-46) Avail: NTIS HC A09/MF A01 CSCL 22/2

The robustness of moving-bank multiple model adaptive estimation (MMAE) and control (MMAC) algorithms is analyzed. The mismatch of a 24-state truth model and a 6-state filter model are evaluated on the basis of MMAE/MMAC performance. A model developed using finite element analysis is used to approximate a large space structure which has a large central hub with appendages radiating out from it. The mass of the hub is considered to be much larger than the mass of the flexible structure. The model is developed in physical coordinates and then transformed into modal coordinates. To obtain a reduced order filter model, the method of singular perturbations is used. The actual positions and velocities of various physical points on the structure are used in the evaluation of the MMAE/MMAC algorithm performance. The results of model mismatching indicates that the MMAE provides accurate position and velocity estimates even in the face of a 6-state to 24-state model mismatch. When a non-adaptive filter is used with a mismatched parameter location, the performance suffers slightly. The use of an adaptive estimator does provide improved performance in the face of uncertain parameter location. Stable control was obtained with the use of MMAC. For the case of nonadaptive filter and mismatched parameter location, the control algorithm behaved in a possible destructive manner. By allowing the filter to adapt to the initial parameter location, the MMAC algorithm provided stable control of the structure, even in the face of lagre disturbances. GRA

N90-16860* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

SUITPORT EXTRA-VEHICULAR ACCESS FACILITY Patent

Marc M. Cohen, inventor (to NASA) 27 Jun. 1989 19 p

(NASA-Case-ARC-11635-1; US-Patent-4,842,224; US-Patent-Appl-SN-110388; US-Patent-Class-244-159; US-Patent-Class-2-2.1A) Avail: U.S. Patent and Trademark Office CSCL 22B

In a system for entering and leaving a space station, a bulkhead divides the module into an antechamber and an airlock. A space suit has a portable life support system (PLSS) interface on its back. The suit is removably attached to the bulkhead by the interface at a hatch in the bulkhead. A PLSS is detachably mounted in the hatch cover, which is pivotally mounted to move away from the hatch to allow an astronaut to enter the suit through the open hatch and the PLSS interface. After entering the suit, the astronaut closes the hatch and attaches the PLSS to the suit by the operating control to which the glove portion of the suit is attached. The astronaut initiates pumpdown of the airlock with the control. When the pumpdown is complete, the astronaut opens the hatch, disconnects the PLSS from the hatch cover, pivots the pressure vessels of the control to one side on their supports, disconnects the glove portions from the pressure vessels and goes EVA.

Official Gazette of the U.S. Patent and Trademark Office

N90-16802# VDK Systems, Brussels (Belgium).

COMPARISON BETWEEN HORIZONTALLY LAUNCHED AIR-BREATHING SINGLE AND TWO-STAGE TO ORBIT SPACE VEHICLES

Jean A. Vandenkerckhove *In* ESA, Progress in Space Transportation Aug. 1989 p 157-16 (For primary document see N90-16782 09-16)

Copyright Avail: NTIS HC A22/MF A03

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

N90-16861# Air Force Geophysics Lab., Hanscom AFB, MA. Space Physics Div.

PROTEL: DESIGN, FABRICATION, CALIBRATION, TESTING, AND SATELLITE INTEGRATION OF A PROTON TELESCOPE Environmental Research Paper

Kristina A. Lynch, Edward A. Boughan, David K. Fischi, David A. Hardy, and Kevin B. Riehl 16 Feb. 1989 86 p

(AF Proj. 7601)

(AD-A214564; AFGL-TR-89-0045; AFGL-ERP-337) Avail: NTIS HC A05/MF A01 CSCL 22/1

A high energy proton telescope, PROTEL, was designed, fabricated, calibrated, tested, and integrated as part of the SPACERAD experiment for the Combined Release and Radiation Effects Satellite (CRRES) payload. As designed, PROTEL measure the differential energy spectrum of protons in 24 channels logarithmically spaced from 1 to 100 MeV, and the approximate

flux of heavy ions. It consists of a Data Processing Unit (DPU), and two sensor head assemblies (High and Low Energy Head). The active elements of the sensor heads are stacked arrays of silicon-lithium drifted and surface barrier solid state detectors. The basic design, the command system, and the telemetry format of PROTEL, as well as the test and calibration results for the detector head assemblies, and electronic logic system obtained with several accelerators are described. Also described are results of computer modeling of the responses of the instrument, particularly the estimation of pulse pileup and efficiency. GRA

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxilliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

N90-16862*# Pratt and Whitney Aircraft, West Palm Beach, FL. Government Engine Business.
SPACE TRANSPORTATION BOOSTER ENGINE CONFIGURATION STUDY. ADDENDUM: DESIGN DEFINITION DOCUMENT Final Report, Apr.1989 - Jul. 1989
1 Dec. 1989 91 p
(Contract NAS8-36857)
(NASA-CR-183854; NAS 1.26:183854; FR-19691-5-Add) Avail: NTIS HC A05/MF A01 CSCL 21H

Gas generator engine characteristics and results of engine configuration refinements are discussed. Updated component mechanical design, performance, and manufacturing information is provided. The results are also provided of ocean recovery studies and various engine integration tasks. The details are provided of the maintenance plan for the Space Transportation Booster Engine. E.R.

N90-16863# Naval Postgraduate School, Monterey, CA.
EFFECTS OF SCALING ON THE PERFORMANCE OF MAGNETOPLASMADYNAMIC THRUSTERS Thesis
Wayne M. Schmidt Jun. 1989 53 p
(AD-A215690) Avail: NTIS HC A04/MF A01 CSCL 21/3

A combined theoretical and empirical numerical model was developed which predicts the performance of continuous electrode coaxial magnetoplasmadynamic thrusters as a function of thruster dimensions, mass flow rate, and input current. This model was used to predict the effects of scaling on these thrusters. The model predicts that for scaling factors down to one-half, relations can be found relating the performance of one thruster to another. The model was used to examine these relationships for four different thruster configurations over a broad range of operating currents. The thrusters examined consisted of two geometries and their half scale counterparts. A conclusion from the analysis is that scaling down the size of the thruster by 50 percent can reduce the total power input by 30 to 40 percent at comparable efficiencies. However, this is at the cost of increasing the specific impulse by a factor of two which may render the thruster inappropriate for the intended missions. GRA

N90-16804*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
SPACE SHUTTLE SOLID ROCKET BOOSTER REDESIGN AND TESTING
R. E. Mitchell *In* ESA, Progress in Space Transportation Aug. 1989 p 173-18 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03 CSCL 21H

N90-16810# Societe Europeenne de Propulsion, Vernon (France).
VULCAIN ENGINE DEVELOPMENT STATUS
Dominique Thevenot, E. Kirner, and D. Thelemann (Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn, Germany, F.R.) *In* ESA, Progress in Space Transportation Aug. 1989 p 215-22 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

N90-16811# Centre National d'Etudes Spatiales, Paris (France).
ARIANE-5 SOLID BOOSTERS STAGE DEVELOPMENT
J. P. Ledey and Alain Coutrot (Europropulsion, Suresnes, France) *In* ESA, Progress in Space Transportation Aug. 1989 p 223-23 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

N90-16812# Centre d'Achevement et d'Essai des Propulseurs et Engins, Saint-Medard-en-Jalles (France).
STATIC TEST DEFLECTOR FOR ARIANE-5 SRM: TECHNICAL DESIGN AND ECONOMICAL CHOICE
J. Sauvel *In* ESA, Progress in Space Transportation Aug. 1989 p 233-24 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

N90-16815# Stuttgart Univ. (Germany, F.R.). Inst. fuer Raumfahrtsysteme.
MISSION-DEPENDENT SELECTION OF PROPULSION SYSTEMS FOR REUSABLE LAUNCH VEHICLES
Ulrich M. Schoettle *In* ESA, Progress in Space Transportation Aug. 1989 p 261-26 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

N90-16820# British Aerospace Public Ltd. Co., Preston (England). Military Aircraft Div.
PERFORMANCE INTEGRATION OF A REUSABLE LAUNCH VEHICLE WITH HYBRID AIRBREATHING ROCKET PROPULSION
Steve G. Furniss and I. M. Walters (British Aerospace Dynamics Group, Stevenage, England) *In* ESA, Progress in Space Transportation Aug. 1989 p 299-30 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

N90-16823# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Space Systems Group.
HERMES PROPULSION SYSTEM
Jochen Hofmann, H. Bassewitz, Vittorio Bombelli, G. Schmidt, and G. Morio (Aerospatiale, Les Mureaux, France) *In* ESA, Progress in Space Transportation Aug. 1989 p 323-33 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

N90-16833*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
THE LIQUID ROCKET BOOSTER AND ITS POTENTIAL FOR THE STS
Paul H. Bialla (General Dynamics Corp., San Diego, CA.) and J. E. Hughes *In* ESA, Progress in Space Transportation Aug. 1989 p 405-41 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03 CSCL 21H

N90-16834# General Dynamics Corp., San Diego, CA.
ARE REUSABLE BOOSTERS COST-EFFECTIVE
Daniel A. Heald *In* ESA, Progress in Space Transportation Aug. 1989 p 411-41 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

N90-16838# Technische Univ., Berlin (Germany, F.R.).
PROPELLANT TRENDS IN ADVANCED ROCKET PROPULSION
Roger E. Lo and Michael Thierschmann *In* ESA, Progress in Space Transportation Aug. 1989 p 449-46 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

N90-16839# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.).
COAXIAL INJECTION TECHNOLOGY FOR HYPERGOLIC PROPELLANTS
G. Schmidt, Guenter Langel, and Helmut Zewen *In* ESA, Progress in Space Transportation Aug. 1989 p 461-46 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

23 CHEMISTRY AND MATERIALS (GENERAL)

No abstracts in this category.

24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.
For ceramic materials see *27 Nonmetallic Materials.*

N90-16864 Salford Univ. (England).
INVESTIGATION INTO THE EFFECT OF FIBRE SIZE ON THE TRIBOLOGICAL BEHAVIOUR OF SEMI-METALLIC BRAKE MATERIAL Ph.D. Thesis
Mohamed Raafat El-Ma Salama 1988 248 p
Avail: Univ. Microfilms Order No. BRD-84979

Improvements in brake materials performance are usually sought by altering their composition or processing conditions. This study investigated the effect of the size of the steel fibers currently used in semi-metallic brake material, as a reinforcing element, on its friction and wear characteristics. The study showed that, apart from enhanced strength, increasing fiber median size has the beneficial effect of improving the low-temperature wear (i.e., adhesive and abrasive wear) of the materials tested. This trend is less marked at high resin level and declines with increasing temperature. The wear of course fiber filled materials is less sensitive to the variations in operational conditions, particularly applied pressure. This trend has been related to the greater mechanical coherence afforded by increasing fiber median size. On the other hand, the fiber size has no substantial effect on the frictional level of the materials tested. This behavior is thought to be due to the counterbalancing effects of the fiber size on the parameters controlling the nature and the thermal stability (thermoelastic instability) of the contacts. The frictional characteristics of these semi-metallics were found to obey Amantons' laws of friction with slight dependency of the frictional coefficient on the sliding velocity. Author

N90-16865 Texas A&M Univ., College Station.
TWO NEW TECHNIQUES FOR PREDICTING DELAMINATION GROWTH IN LAMINATED PLATES Ph.D. Thesis
Barry Daniel Davidson 1988 248 p
Avail: Univ. Microfilms Order No. DA8913346

Two new techniques are developed for predicting delamination growth in laminated plates. Both utilize assumptions consistent with plate theory, and thereby reduce the general delamination growth problem from three dimensions to two. Applications of the techniques are discussed primarily with respect to laminated plates composed of continuous fiber reinforced composite materials. The first technique utilizes a first order shear deformable plate theory and is applicable to mode I fracture problems only. It is shown that the distribution of the energy release rate along the front of a delamination in a double cantilever beam (DCB) specimen as predicted by this technique agrees with that predicted by a three dimensional finite element solution. The technique is utilized along with the results of an experimental and Rayleigh-Ritz study to perform a fundamental investigation into the shape of growing delaminations in DCB specimens as a function of material properties and crack length. The second technique developed utilizes classical plate theory which neglects shear deformation. The total energy release rate is found from the forces acting on a generic crack tip element and broken down into its mode I and II components. This generic crack tip element need only satisfy the conditions that its in-plane dimensions be several times its thickness. Dissert. Abstr.

N90-16866 Texas A&M Univ., College Station.
EFFECTS OF MOISTURE ON COMPOSITE MATERIALS Ph.D. Thesis
Thomas Karl Tsotsis 1989 271 p
Avail: Univ. Microfilms Order No. DA8921783

The objective was to investigate various aspects of the effects of moisture on composite materials in order to obtain a physical-chemical understanding of moisture absorption and damage mechanisms in fiber/polymeric matrix composite materials. The physical and chemical processes accompanying the absorption and diffusion of moisture were assessed by examining different diffusion models for polymers and composites as well as by evaluating their effect on the degradation of properties of composite materials. A mathematical description of damage in composites was formed using solutions to two boundary value problems describing the behavior of an inclusion (fiber) embedded in an infinite matrix both with and without the presence of a circumferential crack. Solutions to these problems were used in conjunction with finite element calculations of the stress state around graphite fibers (in a square or hexagonal array) embedded in epoxy matrix and subjected to thermal and moisture loading in order to characterize fracture due to moisture. Numerical and analytical calculations of the energy available for crack propagation due to thermally- and moisture-induced residual stresses indicate that very low energies are needed to advance such cracks.
Dissert. Abstr.

N90-16867*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Composite Materials and Structures.
A CURE PROCESS MODEL FOR RESIN TRANSFER MOLDING OF ADVANCED COMPOSITES Interim Report No. 75
Steven J. Claus and Alfred C. Loos Apr. 1989 288 p
(Grant NAG1-343)
(NASA-CR-186247; NAS 1.26:186247; CCMS-89-07; VPI-E-89-13)
Avail: NTIS HC A13/MF A02 CSCL 11D

The resin transfer molding (RTM) process was identified as a cost-effective fabrication technique for producing composite materials from geometrically complex reinforcements. Processing models can be used to determine the temperature and pressure cycles which will produce a finished part with the best properties in the shortest time. The development and verification of a processing model for RTM are discussed. The processing model is based on the assumption that infiltration can be described as flow through a porous medium. Flow through porous media, as governed by D'Arcy's law, depends on the viscosity of the fluid and the microstructure of the interconnected pores. Infiltration by thermosetting resin systems is assumed to behave as a Newtonian fluid with a time and temperature dependent viscosity. The kinetics of the resin can be described by mathematical expressions determined from standard thermal analysis techniques. The reinforcement is assumed to be a homogenous, anisotropic material which exhibits strain stiffening, hysteresis and plastic deformation. D'Arcy's law describes the porous material in terms of the material permeability. Kozeny-Carman's relationship is used to relate the porosity to the permeability. Solution of D'Arcy's law is accomplished in a quasi-steady state manner by an evolving mesh finite element technique. After infiltration is completed, the model continues to predict the temperature, degree of cure, and viscosity of the resin. The equations governing the unsteady heat transfer are solved with an existing cure model by the finite difference method. Results of the processing model include estimates of infiltration, gel and cure times as well as the cured thickness and fiber volume fraction. Test laminates were fabricated, mechanically

tested, and compared to prepregged laminate results. Construction of one of the test laminates was simulated with the processing model to verify the accuracy of the simulation. Author

N90-16868*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
EFFECTS OF T-TABS AND LARGE DEFLECTIONS IN DCB SPECIMEN TESTS
R. A. Naik, K. N. Shivakumar (Analytical Services and Materials, Inc., Hampton, VA.), and J. H. Crews, Jr. Nov. 1989 42 p
(NASA-TM-101677; NAS 1.15:101677) Avail: NTIS HC A03/MF A01 CSCL 11D

A simple strength of materials analysis was developed for a double-cantilever beam (DCB) specimen to account for geometric nonlinearity effects due to large deflections and T-tabs. A new DCB data analysis procedure was developed to include the effects of these nonlinearities. The results of the analysis were evaluated by DCB tests performed for materials having a wide range of toughnesses. The materials used in the present study were T300/5208, IM7/8551-7, and AS4/PEEK. Based on the present analysis, for a typical deflection/crack length ratio of 0.3 (for AS4/PEEK), T-tabs and large deflections cause a 15 percent and 3 percent error, respectively, in the computer Mode 1 strain energy release rate. Design guidelines for DCB specimen thickness and T-tab height were also developed in order to keep errors due to these nonlinearities within 2 percent. Based on the test results, for both hinged and tabbed specimens, the effects of large deflection on the Mode 1 fracture toughness (G sub Ic) were almost negligible (less than 1 percent) in the case of T300/5208 and IM7/8551-7; however, AS4/PEEK showed a 2 to 3 percent effect. The effects of T-tabs G sub Ic were more significant for all the materials with T300/5208 showing a 5 percent error, IM7/8551-7 a 15 percent error, and, AS4/PEEK a 20 percent error. Author

N90-16869# Oak Ridge National Lab., TN. Metals and Ceramics Div.
EXTRUSION OF ALUMINA-SILICON CARBIDE WHISKER COMPOSITES
M. A. Janney, E. S. Bomar, and M. C. Vance Oct. 1989 30 p
(Contract DE-AC05-84OR-21400)
(DE90-004379; ORNL/TM-10373) Avail: NTIS HC A03/MF A01

A method was developed to extrude tubes of alumina-silicon carbide whisker composites and the mechanical properties of extruded material were determined. Extruded parts had good strength (approximately 300 MPa) and excellent thermal shock properties (delta T(sub crit) greater than 900 C). Extruded alumina-silicon carbide whisker composites represent a prime candidate for use as heat exchanger tubes. DOE

N90-16870# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, OH. Structural Materials Branch.
INTERFACES OF ORGANIC MATRICES AND GRAPHITE FIBER COMPOSITES: A REVIEW OF THE LITERATURE Final Report, Aug. 1988 - May 1989
Karla L. Strong 8 Jul. 1989 47 p
(AF Proj. 2419)
(AD-A214504; WRDC-TR-89-4063) Avail: NTIS HC A03/MF A01 CSCL 11/4

One of the most interesting and unique problems with advanced organic matrix composites is the fiber/matrix interface (or interphase), which is crucial in determining the material's overall properties. In the past, adhesion between the fiber and matrix has been induced by trial and error. With the current explosion of material systems and the advent of inert thermoplastic matrix materials, much more energy from industry and academia has gone into investigating and defining the interface, yet real scientific understanding eludes them. The current literature concerning the interface between the organic matrix materials and graphite fibers is reviewed. Concepts introduced include wetting, adhesion, fiber surface modification, methods of investigation of fibers and matrices, surface chemistry, and morphology of graphite fibers and organic matrix materials. In addition, the interfacial effort on mechanical properties and interfacial shear strength testing are reviewed. It is determined that a complete scientific understanding of the chemistry, morphology, electrostatic nature, and molecular conformation of the carbon fiber surface and matrix materials is essential to alleviate poor adhesion in organic matrix composites. GRA

N90-16871# Maryland Univ., College Park. Metallurgical Materials Lab.
METAL MATRIX COMPOSITE: STRENGTHENING MECHANISMS Annual Report, Oct. 1988 - Sep. 1989
Richard J. Arsenault Oct. 1989 156 p
(Contract N00014-85-K-0007)
(AD-A214843; MML-1989-1) Avail: NTIS HC A08/MF A01 CSCL 11/4

All of the existing strengthening mechanisms that have been proposed to explain the increase in strength of discontinuous reinforcement composites are based on the assumption that the reinforcement does not perform. However, it appears that TiB2 deforms at high temperature within the NiAl matrix. It has also been observed that there is no apparent dislocation generation due to the difference in coefficient of thermal expansion between TiB2 and NiAl. A finite element investigation has demonstrated how and why the deformation is localized in discontinuous reinforced composites. The addition of discontinuous SiC to Al alloys can result in a five-fold increase in the yield stress and this increase in strength is readily accounted for by changes in the matrix strength. GRA

N90-16872# Aerospace Corp., El Segundo, CA. Materials Sciences Lab.
REVIEW OF POLYARYLACETYLENE MATRICES FOR THIN-WALLED COMPOSITES
W. T. Barry, C. A. Gaulin, and R. W. Kobayashi 25 Sep. 1989 20 p
(Contract F04701-88-C-0089)
(AD-A214921; TR-0089(4935-06)-1; SSD-TR-89-75) Avail: NTIS HC A03/MF A01 CSCL 11/4

Polyarylacetylenes (PAAs) have been successfully employed over the past fifteen years as matrices in the fabrication of thin wall carbon-carbon composites. Because of the proprietary nature of the early polymer, its exact composition was not known. Recent interest in high performance thermal protection systems prompted a detailed reinvestigation of these materials. A brief review of the chemistry of the PAAs involved is discussed in light of the current experiences. The studies reaffirm our belief that these resins are prime candidates for carbon-carbon matrices and offer advantages in fabricability over currently used resins. GRA

N90-16873# Aerospace Corp., El Segundo, CA. Materials Sciences Lab.
EFFECTS OF HEAT TREATMENT ON MICROSTRUCTURE AND FLEXURAL PROPERTIES OF UNIDIRECTIONAL CARBON-CARBON COMPOSITES
Glen A. Binegar, James A. Noblet, Rafael D. Zaldivar, Patrick M. Sheaffer, and Gerald S. Rellick 1 Nov. 1989 38 p
(Contract F04701-88-C-0089)
(AD-A214985; TR-0089(4935-06)-2; SSD-TR-89-87) Avail: NTIS HC A03/MF A01 CSCL 11/4

Microstructure and mechanical behavior of two unidirectional carbon-carbon (C-C) composite systems were studied and correlated with their processing schedules. The composites were made with AMOCO T-50 PAN-based carbon fiber and one of two different carbon matrix precursors. The matrices are a state-of-the-art phenol formaldehyde resin and a polyarylacetylene (PAA) resin obtained from cyclotrimerization of diethynyl benzene. The PAA resins have desirable properties as carbon precursors for C-C composites. The PAA matrix has a high carbon yield of 90 percent and exhibits less shrinkage during carbonization than the phenolic resin. The cyclotrimerized prepolymer also has good processing characteristics because of the molecular weight increase and reduced enthalpy of polymerization that result from

the cyclotrimerization process. Analyses of scanning electron microscope micrographs revealed the appearance of anisotropic structure at heat treatment greater than or equal to 2400 C. The development of this anisotropic structure appears to progress from an initially isotropic texture at 1200 and 1800 C to a graphite-like lamellar anisotropic structure at 2400 C and higher. This anisotropic structure is more pronounced in the PAA-derived matrix. The PAA-derived C-C composites exhibited a change in mode of three-point bend failure at heat treatments of 1800, 2400, and 2800 C. The failure of the 1200 C composites occurred by catastrophic fracture initiating at the tensile face above the loading bar. GRA

N90-16874# Pittsburgh Univ., PA. Dept. of Materials Science and Engineering.
PROGRAM TO STUDY THE OXIDATION OF CARBON-CARBON COMPOSITES AND COATINGS ON THESE MATERIALS Final Report, 15 Jul. 1986 - 13 Jul. 1989
J. Cullinan, J. Schaeffer, E. A. Gulbransen, G. H. Meier, and F. S. Pettit 30 Sep. 1989 209 p
(Grant AF-AFOSR-0251-86; AF Proj. 2306)
(AD-A214989; AFOSR-89-1643TR) Avail: NTIS HC A10/MF A02 CSCL 11/4

The oxidation of carbon-carbon composites and coatings on these composites in oxygen at temperatures between 300 to 1400 C has been investigated. State-of-the art systems have been characterized prior to the oxidation studies by using optical and scanning electron microscopy. It has been determined that uncoated carbon-carbon composites cannot be used at temperatures above about 400 C for extended periods of time because of oxidation. Oxidation does occur at temperatures below 400 C but at very low rates. Boron has not been found to be an effective inhibitor for carbon-carbon oxidation. Water vapor increased the oxidation rate of these uncoated composites at temperatures below about 600 C. Oxidation products involving boron were removed from these composites at temperatures above 600 C when water vapor was present in the gas. Coatings were useful in protecting carbon-carbon composites from oxidation under isothermal test conditions but these coatings failed under cyclic conditions. The factors leading to the failure of coatings on carbon-carbon composites are described. GRA

N90-16875# Cornell Univ., Ithaca, NY. Dept. of Materials Science and Engineering.
RAPID SOLIDIFICATION PROCESSING OF COMPOSITES Final Report, 1 Oct. 1984 - 30 Sep. 1989
Dieter G. Ast and Eric R. Murray Oct. 1989 40 p
(Contract N00014-85-K-0006)
(AD-A215175) Avail: NTIS HC A03/MF A01 CSCL 11/4

Rapid solidification techniques for producing laminated, particle-reinforced, and fiber-reinforced metal-matrix composites are discussed. Because the time for which the different phases of the composite are in contact at high temperature is limited to milliseconds, combinations of materials can be used which would react or degrade when held at these temperatures for the length of time required to form composites by conventional techniques. Rapid quenching to room temperature also allows the production of matrix alloys with non-equilibrium concentrations of elements. Subsequent segregation may improve matrix properties or improve the integrity of the bond at the matrix/reinforcement interface. Additionally, RST is a commercially viable method for producing amorphous alloys in large volumes. GRA

N90-16876# California Univ., San Diego. Dept. of Applied Mechanics and Engineering Sciences.
HIGH-ORDER MIXTURE HOMOGENIZATION OF FIBER-REINFORCED COMPOSITES
A. Toledano and H. Murakami Jun. 1989 45 p
(Contract N00014-87-K-0176)
(AD-A215247) Avail: NTIS HC A03/MF A01 CSCL 11/4

An asymptotic mixture theory of fiber-reinforced composites with periodic microstructure is presented for rate-independent inelastic responses, such as elastoplastic deformation. Key elements are the modeling capability of simulation critical interaction across material interfaces and the inclusion of the kinetic energy of microdisplacement. The construction of the proposed mixture model, which is deterministic, instead of phenomenological, is accomplished by resorting to a variational approach. The principle of virtual work is used for total quantities to derive mixture equations of motion and boundary conditions, while Reissner's mixed variational principle (1984, 1986), applied to the incremental boundary value problem yields consistent mixture constitutive relations. In order to assess the model accuracy, numerical experiments were conducted for static and dynamic loads. The prediction of the model in the time domain was obtained by an explicit finite element code. DYNA2D is used to furnish numerically exact data for the problems by discretizing the details of the microstructure. On the other hand, the model capability of predicting effective tangent moduli was tested by comparing results with NIKE2D. In all cases, good agreement was observed between the predicted and exact data for plastic, as well as, elastic responses. GRA

N90-16877# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
COMPRESSION TESTING OF CARBON FIBERS M.S. Thesis
Thomas A. Doyne Nov. 1989 167 p
(AD-A215296; AD-E501174; AFIT/GSO/ENS/89D-4) Avail: NTIS HC A08/MF A01 CSCL 11/2

In materials engineering, composites are a class of materials made by embedding fibers of one type of material within another material, called the matrix. In general, composite materials possess high strength for their weight, and as a result, composites have been the subject of intensive research in aerospace engineering. The best examples of the use of composites in space are the payload bay doors of the Space Shuttle. GRA

N90-16878*# Michigan Univ., Ann Arbor. Radiation Lab.
A FINITE ELEMENT-BOUNDARY INTEGRAL FORMULATION FOR SCATTERING BY THREE-DIMENSIONAL CAVITY-BACKED APERTURES Technical Report, Sep. 1989 - Feb. 1990
Jian-Ming Jin and John L. Volakis 1990 31 p
(Grant NAG2-541)
(NASA-CR-186332; NAS 1.26:186332; Rept-025921-10-T) Avail: NTIS HC A03/MF A01 CSCL 11D

A numerical technique is proposed for the electromagnetic characterization of the scattering by a three-dimensional cavity-backed aperture in an infinite ground plane. The technique combines the finite element and boundary integral methods to formulate a system of equations for the solution of the aperture fields and those inside the cavity. Specifically, the finite element method is employed to formulate the fields in the cavity region and the boundary integral approach is used in conjunction with the equivalence principle to represent the fields above the ground plane. Unlike traditional approaches, the proposed technique does not require knowledge of the cavity's Green's function and is, therefore, applicable to arbitrary shape depressions and material fillings. Furthermore, the proposed formulation leads to a system having a partly full and partly sparse as well as symmetric and banded matrix which can be solved efficiently using special algorithms. Author

N90-16879*# Martin Marietta Labs., Baltimore, MD.
THE MECHANISMS OF DISPERSION STRENGTHENING AND FRACTURE IN Al-BASED XD (TM) ALLOYS Interim Report, Jul. 1987 - Feb. 1989
R. M. Aiken, Jr. Washington NASA Feb. 1990 86 p
(Contract NAS1-18531)
(NASA-CR-4276; NAS 1.26:4276; MML-TR-89-54c) Avail: NTIS HC A05/MF A01 CSCL 11D

The influence of reinforcement size, volume fraction, and matrix deformation behavior on room and elevated temperature strength, and the fracture toughness of metal matrix composites of both pure aluminum and Al(4 percent)Cu(1.5 percent)Mg with 0 to 15 vol percent TiB2 were examined. Higher TiB2 volume fractions

increased the tensile yield strength both at room and elevated temperatures, and reduced the elongation to fracture. Tensile tests also indicate that small particles provided a greater increase in strength for a given volume fraction than larger particles, whereas elongation to fracture appeared to be insensitive to reinforcement size. The fracture toughness of the Al(4 percent)Cu(1.5 percent)Mg alloys decreased rapidly with TiB2 additions of 0 to 5 vol percent and more slowly with TiB2 additions of 5 to 15 vol percent. Fracture toughness appears to be independent of TiB2 particle size. The isothermal-aging response of the precipitation strengthened Al(4 percent)Cu(1.5 percent)Mg alloys was not altered by the presence of TiB2. Author

N90-16880# Universite de Valenciennes et du Hainaut-Cambresis (France). Lab. d'Opto-Acousto-Electronique.
UTILIZATION OF FOCUSED ACOUSTIC BEAMS TO INSPECT COMPOSITE MATERIALS Final Report [UTILISATION DE FAISCEAUX ACOUSTIQUES FOCALISES POUR L'EXAMEN DE MATERIAUX COMPOSITES]
Rouvaen, Nongaillard, and Ourak 1987 53 p In FRENCH
(Contract DRET-87-137)
(ETN-90-96084) Avail: NTIS HC A04/MF A01

Acoustic microscopy transducers are developed at a frequency of 50 MHz. The curvature radius and delay lines are chosen as a function of the thickness to inspect. The results are compared with those of transducers working at 2 to 5 MHz. A model of acoustic fields is also presented. It is found that ultrasound is too much attenuated by the composite structure. A frequency of 40 MHz would be more suitable. ESA

N90-16881# Aerospatiale, Suresnes (France). Lab. Central.
PHYSICAL CHEMICAL CHARACTERIZATION OF THE SURFACE OF CARBON FIBERS: TEST REPORT [CARACTERISATION PHYSICO-CHIMIQUE DE LA SURFACE DE FIBRES DE CARBONE]
Villatte 5 Aug. 1989 81 p In FRENCH
(Contract DRET-87-34-309)
(Rept-49-740/F; ETN-90-96085) Avail: NTIS HC A05/MF A01

Electron spectrometry and secondary ions mass spectrometry were used to characterize the surfaces. The industrial surface treatments currently practiced lead to the existence of few oxygen functions and show a relative homogeneity within a lot and a good reproducibility from lot to lot. ESA

N90-16882# Institut Franco-Allemand de Recherches, Saint-Louis (France).
NONDESTRUCTIVE CONTROL OF COMPOSITE MATERIALS BY HOLOGRAPHIC INTERFEROMETRY [CONTROLE NON DESTRUCTIF PAR INTERFEROMETRIE HOLOGRAPHIQUE DE PRODUITS COMPOSITES]
A. Stimpfling 25 Oct. 1988 29 p In FRENCH
(ISL-CO-244/88; ETN-90-96093) Avail: NTIS HC A03/MF A01

The application of holographic interferometry of composites control is reviewed. The methods described include real time continuous laser holographic interferometry, real time stroboscopic measurement (modulated laser or repeated pulse laser), double exposure holographic interferometry, and time integration holographic interferometry. The use of pulse lasers enable avoidance of environment constraints such as vibrations and thermal variations. ESA

N90-16883# Lawrence Livermore National Lab., CA. Engineering Sciences Div.
COEFFICIENTS OF THERMAL EXPANSION FOR A CARBON-CARBON COMPOSITE
William W. Feng and Thomas H. Hoheisel 17 Nov. 1989 15 p
(Contract W-7405-eng-48)
(DE90-004484; UCID-21860) Avail: NTIS HC A03/MF A01

From the published data, carbon-carbon composites possess many unique properties at high temperature. The carbon-carbon composites retain their room temperature strength in excess of 2200 C. The low coefficients of thermal expansion (CTE) and the property of non-wetting by molten metals make carbon-carbon composites excellent candidates for applications in the LIS program. Among these unique properties, CTE is the most important factor for the LIS program. In seeking to evaluate typical CTE's we obtained complementary samples of selected carbon-carbon specimens. These samples were laminates with (O2)(sub s), (O2,9O2)(sub s), and (+ or - 45)(sub s) orientations. These results indicated that the selected carbon-carbon composites are almost isotropic in thermal expansion. The CTE's are slightly negative at low temperature and become positive at high temperature. The exact values are shown in the figures. In order to determine the outgassing of carbon-carbon composites, two samples were tested in vacuum. The results have shown that the outgassing can not be neglected. DOE

N90-16884# Lawrence Livermore National Lab., CA.
STRUCTURAL STABILITY OF HEAT TREATED W/B4C MULTILAYERS
A. F. Jankowski Nov. 1989 6 p Presented at the Materials Research Society Fall Meeting, Boston, MA, 27 Nov. - 2 Dec. 1989
(Contract W-7405-eng-48)
(DE90-005322; UCRL-101325; CONF-891119-63) Avail: NTIS HC A02/MF A01

The utilization of W/B4C multilayer structures as Bragg diffractors rests in their reflective efficiency and dependability, both of which rely on the stability of the layered structure. The layers within the vapor deposited multilayers, often amorphous, are typically metastable, hence susceptible to thermally induced structural change. In fact, crystallization and compound formation are known to occur in annealed multilayer systems. In this study, multilayers of W/C W/B4C were vacuum heat treated, then structurally examined. A comparison between the pre- and post-heat treated structures of the two multilayer systems, accomplished using diffraction and electron microscopy, indicate structural stability in the W/B4C multilayers as opposed to structural degradation noted the W/C system. DOE

N90-16885# Lawrence Livermore National Lab., CA. Polymer Composites Group.
ADHESIVE FOR COMPOSITE BONDING
R. E. Lyon, C. M. Walkup, and J. T. Matthews 27 Nov. 1989 6 p
(Contract W-7405-eng-48)
(DE90-005683; UCID-21855) Avail: NTIS HC A02/MF A01

Adhesive bonding is a viable option for structural joining of carbon fiber reinforced epoxy composites. Recent examples from laboratory programs include a composite tube joined to a flared composite collar (skirt) to provide a means for mechanical attachment. Another application involves adhesive bonding of a close-tolerance composite ring to the inside of a tapered, cylindrical composite penetrator case in order to provide a load bearing surface for prestressing the internal package. The adhesive bond in both of these applications is the critical load bearing component and must sustain large shearing stresses in order to maintain the structural integrity and viability of the part. The ideal adhesive would be a low viscosity (less than 10 poise) liquid with a long pot life, good wetting characteristics and high ultimate shear strength when cured at moderate (less than 50 C) temperature. An adhesive with these characteristics would allow for the production of defect-free bonds by capillary wetting or squeezing flow of the adhesive into the narrow annular space between the concentric composite parts. Since adhesives possessing these characteristics were not known to be available commercially, candidate materials were evaluated for this application. In this paper we present bond shear strength data and selected physical properties for some epoxy adhesive formulations. DOE

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*.

N90-16886*# Clemson Univ., SC. Dept. of Ceramic Engineering.
ELECTROCHEMICAL CELL FOR OBTAINING OXYGEN FROM CARBON DIOXIDE ATMOSPHERES
Matthew Hooker, H. Edward Rast, Darren K. Rogers, Luis Borja, Kevin Clark, Kimberly Fleming, Michael McGurren, Tom Oldaker, and Nanette Sweet 1 Jul. 1989 32 p
(Contract NASw-4435)
(NASA-CR-186225; NAS 1.26:186225) Avail: NTIS HC A03/MF A01 CSCL 07D

To support human life on the Martian surface, an electrochemical device will be required to obtain oxygen from the carbon dioxide rich atmosphere. The electrolyte employed in such a device must be constructed from extremely thin, dense membranes to efficiently acquire the oxygen necessary to support life. A forming process used industrially in the production of multilayer capacitors and electronic substrates was adapted to form the thin membranes required. The process, known as the tape casting, involves the suspension consisting of solvents and binders. The suspension is passed under a blade, resulting in the production of ceramic membranes between 0.1 and 0.5 mm thick. Once fired, the stabilized zirconia membranes were assembled into the cell design by employing a zirconium phosphate solution as the sealing agent. The resulting ceramic-to-ceramic seals were found to be structurally sound and gas-tight. Furthermore, by using a zirconia-based solution to assemble the cell, the problem of a thermal expansion mismatch was alleviated. By adopting an industrial forming process to produce thin membranes, an electrochemical cell for obtaining oxygen from carbon dioxide was produced. The proposed cell design is unique in that it does not require a complicated manifold system for separating the various gases present in this process, nor does it require a series of complex electrical connections. Thus, the device can reliably obtain the vital oxygen supply from the toxic carbon dioxide atmosphere. Author

N90-16887*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
MICROPOROUS STRUCTURE WITH LAYERED INTERSTITIAL SURFACE TREATMENT, AND METHOD AND APPARATUS FOR PREPARATION THEREOF Patent Application
Steven L. Koontz, inventor (to NASA) 31 Oct. 1989 24 p
(NASA-Case-MSC-21487-1; NAS 1.71:MSC-21487-1; US-Patent-Appl-SN-429739) Avail: NTIS HC A03/MF A01 CSCL 07D

A microporous structure with layered interstitial surface treatments, and the method and apparatus for its preparation are disclosed. The structure is prepared by sequentially subjecting a uniformly surface treated structure to atomic oxygen treatment to remove an outer layer of surface treatment to a generally uniform depth, and then surface treating the so exposed layer with another surface treating agent. The atomic oxygen/surface treatment steps may optionally be repeated, each successive time to a lesser depth, to produce a microporous structure having multilayered surface treatments. The apparatus employs at least one side arm from a main oxygen-containing chamber. The side arm has characteristic relaxation times such that a uniform atomic oxygen dose rate is delivered to a specimen positioned transversely in the side arm spaced from the main gas chamber. NASA

N90-16888*# San Diego State Univ., CA. Molecular Engineering Lab.
FLUORESCENCE FROM PHOTOEXCITATION OF Cl2 AT 50 TO 105 nm
Guang Ma, Chao Ye, Masako Suto, and L. C. Lee 1990 18 p
Sponsored in part by NSF, Washington, DC
(Grant NAGw-319)
(NASA-CR-186206; NAS 1.26:186206) Avail: NTIS HC A03/MF A01 CSCL 07D

The photoabsorption and fluorescence cross sections of Cl2 were measured in the 50 to 105 nm region. Excitation of Cl2 in the 90 to 109 nm region emits two UV bands with peaks at 258 and 307 nm. The emission bands are attributed to the Cl2(D' to A') transition that is produced by the energy transfer from Cl*(4P 5/2) to Cl2. The Cl2(+)(A to X) emission band is produced at the excitation wavelengths shorter than 89 nm. Author

N90-16889# BioPhotonics, Inc., Greenfield, WI.
BIOLUMINESCENCE FOR DETECTION OF TRACE COMPOUNDS
Reinhardt A. Rosson 13 Oct. 1989 4 p
(Contract N00014-89-C-0251)
(AD-A213458) Avail: NTIS HC A01/MF A01 CSCL 06/11

The purpose of this investigation is to demonstrate the feasibility of bioluminescent testing for detection of toxic compounds and to develop an inexpensive photodiode based light detection system for field measurement of low level bioluminescence. Progress in the following areas is reported: (1) detection of carcinogens using cloned lux genes in various strains of E. coli; (2) stabilization and immobilization of E. coli biosensors by lyophilization; and (3) development and fabrication of a portable photodiode light detection system. GRA

N90-16890# Sao Paulo Univ. (Brazil). Inst. de Fisica.
KOSTERLITZ-THOULESS PHASE TRANSITION IN TWO-DIMENSIONAL HIERARCHICAL COULOMB GASES
D. H. U. Marchetti and J. Fernando Perez Nov. 1988 30 p
Submitted for publication
(Grant CNPq-303795-77FA)
(DE89-618399; IFUSP-P-756) Avail: NTIS (US Sales Only) HC A03/MF A01

A hierarchical version of 2-D lattice Coulomb gases is investigated. For beta greater than beta (sub c) = 8PI there is a locally stable line of fixed points for the Renormalization Group (block charges) transformations. For beta greater than beta (sup -)(sub c) beta (sub c) less than or = beta (sup - (sub c) less than or = 3PI/2 beta (sub c), these fixed points are globally stable. As a consequence, there is no screening of external charges for any activity if beta greater than beta (sup -)(sub c). At beta (sub c) a supercritical bifurcation takes place and the behavior of the model for beta less than or approx., beta (sub c) as to show a weak form of screening, is investigated. DOE

N90-16891# Oak Ridge National Lab., TN.
QUALITY CONTROL PROGRAMS FOR ISOTOPE DILUTION MASS SPECTROMETRY
C. K. Bayne 11 Dec. 1989 11 p
(Contract DE-AC05-84OR-21400)
(DE90-004259; ORNL/CSD/FTR-3495) Avail: NTIS HC A03/MF A01

This visit to the Safeguards Analytical Laboratory (SAL) examined the procedures for isotope dilution analysis by mass spectrometry (IDMS) and the procedures for calibrating each ion collector on multicollector mass spectrometers. Quality control data were collected to develop a simulation program of the IDMS procedure. This simulation program will be used to analyze the effects of measurement errors on the final uranium and plutonium concentration calculations. An experiment for calibrating multicollectors was designed to examine the effect of temperature changes during an isotopic measurement. The results will be sent to ORNL for statistical analysis. DOE

N90-16892# Army Armament Research, Development and Engineering Center, Watervliet, NY.
DETERMINATION OF IRON IN CHROMIUM PLATING AND POLISHING SOLUTIONS BY ATOMIC ABSORPTION SPECTROMETRY Final Report

Samuel Sopok Oct. 1989 16 p
(AD-A214467; ARCCB-TR-89026) Avail: NTIS HC A02/MF A01 CSCL 20/5

The chemical literature lacks a specific analytic method for adequately monitoring iron in chromium plating and polishing solutions during the plating and polishing processes. In this report, a specific method is presented for analyzing and monitoring iron during these processes. The optimum operating range of the iron is generally around 10 g/1 maximum in both the chromium plating and the polishing solutions. The resulting precisions are in the range of 0.5 to 1.5 g/1, providing adequate monitoring of these solutions supported by six years of testing. GRA

N90-16893# California Univ., Davis.
ACQUISITION OF ANALYTICAL INSTRUMENTS FOR COMBUSTION RESEARCH Final Report, 1986 - 1989
C. K. Law 15 Sep. 1989 3 p
(Grant AF-AFOSR-0226-86; AF Proj. 2917)
(AD-A214495; AFOSR-89-1287TR) Avail: NTIS HC A01/MF A01 CSCL 21/2

A set of thermal analytical instruments and a quadruple mass spectrometer have been acquired for the determination of variations in concentration and chemical composition in reactive systems as well as the identification of key heat-release mechanism and the energetics of new fuel, propellant formulation. The specific instruments acquired are listed. GRA

N90-16894# State Univ. of New York, Stony Brook. Dept. of Chemistry.
CLUSTER BASED REACTION PROBABILITIES FOR BORON WITH OXYGEN, HYDROGEN, WATER, NITROGEN, NITROUS OXIDE, CARBON DIOXIDE, CARBON MONOXIDE, METHANE, TETRAFLUOROMETHANE, AND SILANE Interim Report
Paul A. Hintz, Stephen A. Ruatta, and Scott L. Anderson 28 Oct. 1989 27 p
(Contract N00014-85-K-0678)
(AD-A214554; SBIL-A89) Avail: NTIS HC A03/MF A01 CSCL 07/4

Since the beginning of the detailed study of boron cluster ion reaction dynamics, the cross section measurements have been in a form most useful to combustion modelers and others interested in the reactivity of boron, and in oxidation processes in particular. An effective way found to do this is to convert the data into reaction efficiencies or the probability of reaction per surface collision. By calculating these reaction probabilities as a function of temperature, combustion modelers can be provided with the necessary data to calculate reaction rates for boron combustion processes under whatever conditions seem appropriate. The kinetic parameters are based on averages of cross sections measured for reactions of boron cluster ions with the gases in question. Both total reaction probabilities and also the branching fractions to different products are presented. The method for converting from cross sections to rates is discussed and results are given for reaction with oxygen, hydrogen, nitrogen, nitrous oxide, water methane, fluoromethane, carbon dioxide, carbon monoxide, and silane. GRA

N90-16895# Utah Univ., Salt Lake City. Dept. of Electrical Engineering.
RAMAN SPECTROSCOPIC ANALYSIS OF IMPREGNATED CATHODES Final Technical Report, Sep. 1986 - Dec. 1988
S. B. Turcotte, J. R. Mitchell, R. E. Benner, and R. W. Grow Sep. 1989 37 p
(Contracts F30602-84-C-0153; N00014-86-K-0258; N00014-86-K-0710; AF Proj. 2305)
(AD-A214559; UTEC-MD-89-017; RADC-TR-89-143) Avail: NTIS HC A03/MF A01 CSCL 09/1

Two optical detection systems were used to obtain Raman spectra from impregnant samples, tungsten pellets, and cathode surfaces. The advantages of each system are described and their use for cathode diagnostics are explored. The Raman spectra from various impregnant samples are given and preliminary data from tungsten pellets and cathodes at low pressure and at temperatures as high as 860 C are presented. GRA

N90-16896# Emory Univ., Atlanta, GA. Dept. of Biology.
COMBUSTION OF HYDROGEN AND HYDROCARBONS IN FLUORINE Final Report, 1 Aug. 1984 - 31 Jul. 1989
Myron Kaufman 3 Sep. 1989 29 p
(Grant AF-AFOSR-0196-84; AF Proj. 2308)
(AD-A214621; AFOSR-89-1330TR) Avail: NTIS HC A03/MF A01 CSCL 21/2

The program is directed towards increasing understanding of combustion processes in general, as well as advancing the application of fluorine-supported combustion in areas such as propulsion and chemical lasers. Since fluorine is monovalent, combustion in fluorine is chemically much simpler than combustion in oxygen. However, in fluorine-based combustion most of the energy is initially deposited into vibration (of HF), and transfer of energy from vibrationally excited species must be considered. Experiments in H2-F2 flames to which very small amounts of Methane have been added are particularly revealing and indicate that the most likely mechanism for explaining luminescence from CH and CHF radicals in these flames is vibration-to-electronic energy transfer from highly vibrationally excited HF. C2 emission probably results from the CH + CH yields C2* + H2 reaction. These conclusions suggest that the ratio I(CH)/(ICH2)1/2 is a useful diagnostic for vibrationally excited HF in H2-F2 propulsion and laser systems. Ionization is not intrinsic to fluorine-hydrocarbon combustion, but often results from oxygen impurity in fluorine. Fluorine combustion systems show a variety of nonsteady behaviors, which are postulated to be due to changes in concentrations of vibrationally excited species in the system. The method of kinetic titrations was developed to obtain stoichiometric, kinetic and mechanistic information about chemical reactions. GRA

N90-16897# Aerospace Corp., El Segundo, CA. Chemistry and Physics Lab.
STUDIES OF THE STRUCTURE AND PROPERTIES OF AMORPHOUS a-Zr76Fe24Hx
R. C. Bowman, Jr., A. J. Maeland, K. M. Unruh, E. L. Venturini, J. J. Rush, and J. S. Cantrell (Miami Univ., Oxford, OH.) 31 May 1989 12 p
(Contract F04701-85-C-0086)
(AD-A214646; TR-0088(3057)-2; SD-TR-89-70) Avail: NTIS HC A03/MF A01 CSCL 11/6

The a-Zr76Fe24Hx samples with x less than or = 173 have been shown to remain amorphous after reaction of the glassy alloy with gaseous hydrogen. Magnetic susceptibility and Mossbauer spectroscopy indicate that the electronic structure of the alloy is modified upon hydrogen absorption. Proton spin lattice relaxation times suggest a strong hyperfine interaction with the iron d-states. The vibrational spectrum of a-Zr7+Fe24H173 from inelastic neutron scattering shows hydrogen occupancy in a distribution of tetrahedral interstitial sites. Calorimetry and x ray diffraction demonstrate that a Zr76Fe24H(x) with x greater than 140 irreversibly crystallizes into c-Zr(Hx) and ZrFe2. GRA

N90-16898# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
DESCRIPTIVE SIMULATION: COMBINING SYMBOLIC AND NUMERICAL METHODS IN THE ANALYSIS OF CHEMICAL REACTION MECHANISMS
Michael Eisenberg Sep. 1989 26 p
(Contract N00014-86-K-0180)
(AD-A214678; AI-M-1171) Avail: NTIS HC A03/MF A01 CSCL 07/4

The Kineticist's Workbench is a computer program currently under development whose purpose is to help chemists understand, analyze, and simplify complex chemical reaction mechanisms. This paper discusses one module of the program that numerically simulates mechanisms and constructs qualitative descriptions of the simulation results. These descriptions are given in terms that are meaningful to the working chemist (e.g., steady states, stable

oscillations, and so on); and the descriptions (as well as the data structures used to construct them) are accessible as input to other programs. GRA

N90-16899# Brown Univ., Providence, RI. Dept. of Chemistry.
NEW ELECTRONIC MATERIALS AND CO2 REDUCTION Final Report, 1 May 1986 - 31 Oct. 1989
Aaron Wold 10 Nov. 1989 6 p
(Contract N00014-86-K-0234)
(AD-A214679) Avail: NTIS HC A02/MF A01 CSCL 17/4

Research in the area of catalysis at Brown deals with the development of low temperature synthetic methods for the preparation of well-dispersed catalysts (Iron oxide, Chromic oxide, Rhodium oxide and Nickel oxide) on several oxide supports (ZrO2, TiO2). Physical methods, such as x ray diffraction, magnetic susceptibility and temperature programmed reduction, are used to study the interaction between the dispersed metal oxide and the support. The extent of substitution of nickel into Fe5C2 was also studied since both nickel and iron are Fischer-Tropsch catalysts. A thermomagnetic balance has been constructed and is being used to determine the nucleation and growth of catalytically active magnetic phases which can be correlated at the same time with the temperature reduction data. A new effort was started dealing with the chemical properties associated with the preparation and characterization of the new superconducting oxides containing copper. A project presently deals with the preparation of complex oxides of copper in order to ascertain the effect of the A-site ion on the superconducting properties of substituted La2CuO4 and Ba2YCu3O7. The investigation is being extended to other oxides of copper, e.g. Y2Cu2O5 and La2CaCu2O6. An effort has been started on the growth of thin films of superconductors by the use of spray pyrolysis. GRA

N90-16900# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
THEORETICAL STUDY OF THE TOWNES-MERRITT EFFECT IN LEVEL CROSSING EXPERIMENTS Ph.D. Thesis
William R. White Sep. 1989 114 p
(AD-A214909; AFIT/DS/ENP/89-2) Avail: NTIS HC A06/MF A01 CSCL 20/5

A high resolution spectroscopic technique using a nonresonant RF field in a level crossing experiment is proposed. Absorption sidebands, originally observed by Townes and Merritt (1947), are analyzed using a quantum electrodynamic (QED) approach. A model is developed using the Heisenberg operator formalism and the adiabatic approximation to describe the atomic dynamics. Results agree with a dressed states approach and the original experiment. The model is extended to a three level atom to describe level crossings and quantum beats for linear and quadratic Stark shifted atoms. Expressions are developed to define level crossings conditions and estimate critical experimental parameters. GRA

N90-16901# California Univ., Berkeley. Dept. of Chemistry.
TRANSITION STATE SPECTROSCOPY OF HYDROGEN TRANSFER REACTIONS Interim Technical Report No. 2, May - Nov. 1989
Daniel M. Neumark 29 Nov. 1989 18 p
(Contract N00014-87-K-0495; AF-AFOSR-0341-87)
(AD-A215041) Avail: NTIS HC A02/MF A01 CSCL 20/5

The transition state region for several chemical reactions of the type A + HB yields HA + B has been investigated via photodetachment of the stable negative ion AHB-. The photoelectron spectra of BrHBr- and BrHI- show resolved vibrational structure attributable to the transition state region of the Br + HBr and Br + Hi reactions, respectively. The photoelectron spectra of IDI- and the cluster ion IDI-(N2O) are compared; these spectra probe different parts of the I + HI potential energy surface. Finally, a high resolution threshold photodetachment spectrum of one of the IHI- features shows evidence for reactive resonances in the I + HI reaction. GRA

N90-16902# Pittsburgh Univ., PA. Dept. of Chemistry.
HIGHLY REDUCED CARBENE COMPLEXES: FORMATION OF AN ALKOXYMALONATE BY COUPLING OF CARBON DIOXIDE WITH THE NUCLEOPHILIC CARBENE IN Cr(CO4)=C(OMe)Ph2(-)
Samkeun Lee and N. John Cooper 17 Nov. 1989 11 p Submitted for publication
(Contract N00014-87-K-0288)
(AD-A215132) Avail: NTIS HC A02/MF A01 CSCL 07/3

Reduction of a mixture of cis and trans (Cr(CO)4(PBu3)(C-(OMe)Ph)) with 2.0 equiv. of potassium naphthalenide leads to formation of a highly reduced complex with carbonyl absorptions at 1859(s) and 1737(s)/cm, consistent with formation of the dianionic carbene complex (Cr(CO)4(C(OMe)Ph))(2-)(1(2-)). A crystalline salt of 1(2-) can be obtained by 18-crown-6 complexation of the K+ counterion of samples prepared by reduction of trans(Cr-(CO)4(PCy3)-(C(OMe)Ph)). The proposed formulation is supported by an unprecedented bis-carboxylation of the carbene ligand in 12- to give the unusual methoxy-malonate K2(Ph(MeO)C(CO2))2 (K25, 82 percent), characterized by H+/CH2N2 esterification to give Ph(MeO)C(CO2Me)2 in 85 percent yield. The malonate K25 can be prepared directly from readily available (Cr(CO)5(C(OMe)-Ph)) (2) in a single pot in 53 percent overall yield. GRA

N90-16903# Pittsburgh Univ., PA. Dept. of Chemistry.
HYDROGEN DESORPTION FROM THE MONOHYDRIDE PHASE ON Si(100)
Kumar Sinniah, Michael G. Sherman, Lisa B. Lewis, W. Henry Weinberg, John T. Yates, Jr., and Kenneth C. Janda 10 Nov. 1989 63 p
(Contract N00014-82-K-0280)
(AD-A215237; TR-27) Avail: NTIS HC A04/MF A01 CSCL 20/5

The kinetics of the thermal recombinative desorption of hydrogen from the monohydride phase on the Si(100) surface has been studied by laser-induced thermal desorption (LITD). A rate law that is first order in the atomic hydrogen coverage with an activation energy of 45 kcal/mol gives an accurate fit to the data over a temperature range of 685 to 790 K and a coverage range of 0.006 to 1.0 monolayer. A new mechanism is proposed to explain these surprising results, namely, that the rate limiting step of the reaction is the promotion of a hydrogen atom from a localized bonding site to a delocalized band state. The delocalized atom then reacts with a localized atom to produce molecular hydrogen which desorbs. Evidence to support these conclusions comes from isotopic mixing experiments. Studies of recombinative desorption from other surfaces of silicon, which had been assumed to obey second-order kinetics, are discussed in the light of these results. GRA

N90-16904# Boeing Co., Seattle, WA.
STUDY OF CHEMICAL SYSTEMS IN STATIC AND TIME RESOLVED MODE BY X RAY ABSORPTION SPECTROSCOPY Final Report, 1985 - 1989
Donald R. Sandstrom 30 Nov. 1989 6 p
(Contract N00014-85-C-0207)
(AD-A215383) Avail: NTIS HC A02/MF A01 CSCL 20/2

The project objective was to develop new experimental x ray absorption (XAS) techniques for application to studies in metal-containing coordination complexes in dynamic systems. Two new XAS approaches were advanced: single pulse time resolved XAS and gas phase XAS. Our investigations of the time-resolved technique involved design of advanced circuitry for accurate single-pulse x ray detection, definition of requirements for sufficiently accurate x ray measurements and evaluation and understanding of time structure modulations and sources of noise in synchrotron radiation beams. GRA

N90-16905# General Electric Co., Schenectady, NY. Research and Development Center.
FEEDBACK CONTROL OF COMBUSTION INSTABILITIES: A CASE STUDY IN ACTIVE ADAPTIVE CONTROL OF COMPLEX PHYSICAL SYSTEMS Annual Report, 1 Mar. - 30 Sep. 1989
Anil Gulati and George C. Goodman 30 Sep. 1989 18 p
(Contract N00014-89-C-0052)
(AD-A215385) Avail: NTIS HC A02/MF A01 CSCL 21/2

Active control of combustion instability was studied in a laboratory scale combustor based on fuel flow modulation or an alternative practical means of actuation. A model was developed of the plant taking into account the complex physical mechanisms responsible for screech in a liquid fueled combustor to help design a robust controller. The model should also account for possible interactions between the controller and the plant. A controller was designed to suppress screech based on open-loop frequency response data. The controller was implemented and active control of screech was demonstrated based on liquid fuel flow modulation. The range was determined of application of the controller in terms of flow rates and equivalence ratios. Feasibility was assessed of nonadaptive, scheduled and adaptive control strategies to design a robust controller to achieve full-envelope control of combustion instability. A general design process was developed which is applicable to a practical combustor operating over a wide range of input conditions. Promising approaches were identified and candidate strategies were selected for implementation and these were tested on the existing combustor. Extension of active control was explored to suppress transverse mode high frequency oscillations expected in afterburner screech. Identify performance limits of commercially available hardware and explore alternative means of actuation. GRA

N90-16906# Leeds Univ. (England).
KINETICS OF BORON HYDRIDE INTERCONVERSION REACTIONS Final Technical Report, May 1986 - Sep. 1989
R. Greatrex and N. N. Greenwood Sep. 1989 97 p Sponsored in part by Science Research Council
(Contract DAJA45-86-C-0019)
(AD-A215386; R/D-5004-CH-01-F) Avail: NTIS HC A05/MF A01 CSCL 07/2

The complex series of gas phase reactions that occur during the thermolysis of diborane are described. This has involved the application of a mass spectrometric technique developed in this laboratory to monitor initial rates of reaction and product distributions, leading to rate equations, orders of reaction, and energies of activation. GRA

N90-16907# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CHEMICAL PROFILING OF SILICON NITRIDE STRUCTURES Final Technical Report, Oct. 1985 - Jun. 1987
R. P. Vasquez Jun. 1989 137 p
(AF Proj. 2306)
(AD-A215643; RADC-TR-89-75) Avail: NTIS HC A07/MF A01 CSCL 20/12

X ray photoelectron spectroscopy (XPS), spectroscopic ellipsometry (SE), and scanning electron microscopy (SEM) were used to study structural and chemical inhomogeneities in several electronic materials and device structures of relevance to radiation hard electronics. The systems studied include metal nitride oxide semiconductor (MNOS) structures, silicon oxynitride (SiO(x)N(y)) formed by the thermal nitridation of SiO2, and semiconductor on insulator (SOI) structures. Studies of MNOS structures suggest that the effect of H2 annealing is to make the Si3N4/SiO2 interface less abrupt by causing interdiffusion of silanol and silamine groups with subsequent oxynitride formation. Another effect of the annealing appears to be to relieve the strain at the SiO2/Si interface. GRA

N90-16908# Institut Franco-Allemand de Recherches, Saint-Louis (France).
MEASUREMENT OF THE SPEED AND TEMPERATURE OF IGNITION GASES [MESSUNG DER GESCHWINDIGKEIT UND TEMPERATUR VON ANZUENDSCHWADEN]
H. Mach, U. Werner, and H. Masur 7 Nov. 1988 33 p In GERMAN Presented at the Rahmen des Carl-Cranz-Lehrgangs B 5.03 An- und Abbrandvorgaenge von Treitbladungspulvern, Weil am Rhein, Federal Rep. of Germany, 24-28 Oct. 1988
(ISL-CO-246/88; ETN-90-96094) Avail: NTIS HC A03/MF A01

Methods of measuring the speed and temperature of gases ejected by propulsive charge are described. Three different cases are considered: expansion of ignition gases into the open, ejection through a nozzle under pressure, and ejection into a bed of confined powder. The propulsive powder is replaced by inert granular material in these simulations. Gas escape speeds are measured using a laser interferometry. Gas temperature is measured by spectrographic analysis of the visible wavelengths and infrared wavelengths of light emitted by the gas. The use of these speed and temperature measurements in determining the energy and mass flux from burners is described. ESA

N90-16909# Oak Ridge National Lab., TN. Analytical Chemistry Div.
SPARK SOURCE MASS SPECTROMETRY SOFTWARE DOCUMENTATION AND VERIFICATION
David O. Vick, Larry Landau, and Warner H. Christie Dec. 1989 31 p
(Contract DE-AC05-84OR-21400)
(DE90-004463; ORNL/TM-11328) Avail: NTIS HC A03/MF A01

The Analytical Spectroscopy Section of the Analytical Chemistry Division has had software to process spark source mass spectrometric (SSMS) data in operation for over two decades. Although the system was verified in analysis of standards numerous times through out its operation, documentation was never of primary concern. In recent years the quality assurance (QA) requirements by both Martin Marietta Energy Systems (MMES) and various sponsoring agencies have increased. The documentation, verification, and validation of the software used to process SSMS data that will satisfy the QA requirements of most analytical programs are provided. The operation of each of the three major computer routines (EMLCAL, PLATE, PEAK) is described in enough detail to give a clear understanding of its function. Verification was accomplished by comparing code results to hand calculations, to physical data, and to an alternative code designed to perform the same type of analysis. Validation was accomplished by an isotopic analysis of a natural erbium standard and comparison of the results with the accepted isotopic abundances. Appendices contain user instructions, samples of outputs, examples of the data files, and definitions of all the labels and variables used within the program code. DOE

N90-16910# Lawrence Livermore National Lab., CA.
THE FUNDAMENTALS OF METAL COMBUSTION IN COMPOSITE EXPLOSIVES REVEALED BY HIGH SPEED MICROPHOTOGRAPHY
William C. Lao, Allan M. Frank, Joseph E. Shepherd (Rensselaer Polytechnic Inst., Troy, NY.), and Rochelle E. Clements Nov. 1989 13 p Presented at the 9th International Symposium on Detonation, Portland, OR, 28 Aug. - 1 Sep. 1989
(Contract W-7405-eng-48)
(DE90-005255; UCRL-102282; CONF-890811-41) Avail: NTIS HC A03/MF A01

High-speed and high resolution microphotography was used to examine the ignition and combustion of small 25 to 76 micrometer diameter and 23 mm long aluminum wires in water, rapidly heated by a capacitor discharge system. Streak photographs were obtained over periods of 30 to 500 micrometers with a spatial resolution of 2 micrometers. The wire temperature was determined as a function of time by integrating the circuit equation together with the energy equation for an adiabatic wire and known aluminum electrical

resistivity and temperature functions of energy density. A transition was discovered in the ignition and combustion of the aluminum from mild to rapid sustained chemical reaction with the water when the wire is heated above a critical temperature within 1 micrometer. The triggering mechanism for this rapid reaction appears to be the collapse of a vapor blanket during its first oscillation. DOE

N90-17099*# Rice Univ., Houston, TX. Dept. of Chemical Engineering.
THEORY OF MICROEMULSIONS IN A GRAVITATIONAL FIELD
J. F. Jeng and Clarence A. Miller *In* NASA, Lewis Research Center, NASA Laser Light Scattering Advanced Technology Development Workshop, 1988 Aug. 1989 p 199-214 (For primary document see N90-17085 09-35)
Avail: NTIS HC A14/MF A02 CSCL 07D

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N90-16911*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THERMAL MODELLING OF VARIOUS THERMAL BARRIER COATINGS IN A HIGH HEAT FLUX ROCKET ENGINE
James A. Nesbitt Dec. 1989 31 p
(NASA-TM-102418; E-5184; NAS 1.15:102418) Avail: NTIS HC A03/MF A01 CSCL 11F

Traditional Air Plasma Sprayed (APS) ZrO2-Y2O3 Thermal Barrier Coatings (TBC's) and Low Pressure Plasma Sprayed (LPPS) ZrO2-Y2O3/Ni-Cr-Al-Y cermet coatings were tested in a H2/O2 rocked engine. The traditional ZrO2-Y2O3 (TBC's) showed considerable metal temperature reductions during testing in the hydrogen-rich environment. A thermal model was developed to predict the thermal response of the tubes with the various coatings. Good agreement was observed between predicted temperatures and measured temperatures at the inner wall of the tube and in the metal near the coating/metal interface. The thermal model was also used to examine the effect of the differences in the reported values of the thermal conductivity of plasma sprayed ZrO2-Y2O3 ceramic coatings, the effect of 100 micron (0.004 in.) thick metallic bond coat, the effect of tangential heat transfer around the tube, and the effect or radiation from the surface of the ceramic coating. It was shown that for the short duration testing in the rocket engine, the most important of these considerations was the effect of the uncertainty in the thermal conductivity of temperatures (greater than 100 C) predicted in the tube. The thermal model was also used to predict the thermal response of the coated rod in order to quantify the difference in the metal temperatures between the two substrate geometries and to explain the previously-observed increased life of coatings on rods over that on tubes. A thermal model was also developed to predict heat transfer to the leading edge of High Pressure Fuel Turbopump (HPFTP) blades during start-up of the space shuttle main engines. The ability of various TBC's to reduce metal temperatures during the two thermal excursions occurring on start-up was predicted. Temperature reductions of 150 to 470 C were predicted for 165 micron (0.0065 in.) coatings for the greater of the two thermal excursions. Author

N90-16912# Bureau of Mines, Albany, OR. Research Center.
HEAT-RESISTANT STEELS CONTAINING 8 PCT Cr
Darrell E. Larson 1989 17 p Sponsored by Bureau of Mines, Washington, DC
(PB90-108796; BUMINES-RI-9255; LC-89-30369) Avail: NTIS HC A03/MF A01 CSCL 11F

The study reduced the amount of Cr required to make an austenitic stainless steel while retaining satisfactory workability, mechanical properties, and oxidation resistance. Alloys prepared in the investigation had a composition of Fe-8Cr-1Mn-0.07C with varying amounts of Ni, Al, and Si. A minimum of 10 percent Ni was required to achieve an austenitic composition. The microstructures of the austenitic alloys were very susceptible to room-temperature, deformation-induced martensitic transformations. When the alloys were cold-worked or stressed, the materials had far greater tensile strengths than Type 304 SS at room temperature. At higher temperatures, tensile strengths and workability of several of the alloys were comparable to that of Type 304 SS. Although martensitic transformation caused the room-temperture properties of the experimental alloys to be quite different than those of Type 304 SS, the superior oxidation resistance and similar hot workability of several alloys encourage their use as replacements for Type 304 SS. GRA

N90-16913# International Centre for Theoretical Physics, Trieste (Italy).
MECHANICS OF IRON, ITS STABILITY AND PHASE TRANSFORMATION
K. P. Thakur and O. P. Thakur (Indian Inst. of Tech., New Delhi.) Apr. 1989 33 p Submitted for publication
(DE89-636210; IC-89/64) Avail: NTIS (US Sales Only) HC A03/MF A01

The comprehensive investigation of the mechanics of iron subjected to arbitrary fluid pressure was performed. Apart from the classical elastic moduli (k, M, and M') and conventional elastic moduli (Green and stretch moduli) computations are performed for the family of generalized moduli of which the conventional moduli are just the specific members. With the generalized moduli the mechanical stability of iron is investigated through Born criteria. It is found that classical stability, Green stability, and stretch stability are all represented uniquely by the present generalized scheme. The definition of effective classical moduli under stresses enabled the amalgamation of the Born criteria of lattice stability into the single classical criteria of lattice stability of cubic crystal under hydrostatic loading environment. Computations are also performed to investigate the coordinate and stress dependence of Young's modulus of elasticity, Poisson's ratio, mean velocity of elastic wave, and Debye temperature. Surprisingly, it is found that all these properties of solids play an important role in representing the mechanical stability of the solid. The path of uniaxial loading of iron is also investigated along with its internal energy variation on this path. This indicated the existence of stress-free fcc phase of iron on the path of uniaxial deformation at cell length a = 3.6444 A giving enthalpy of transformation (bcc yields fcc) of 1.1 kJ/mol in good agreement with experimental results. DOE

N90-16914# Pacific Northwest Lab., Richland, WA.
PHASE STABILITY OF A MANGANESE-STABILIZED LOW-ACTIVATION MARTENSITIC STEEL
R. D. Griffin, D. S. Gelles, R. A. Dodd, and G. L. Kulcinski (Wisconsin Univ., Madison.) Dec. 1989 13 p Presented at the 4th International Conference on Fusion Reactor Materials, Kyoto (Japan), 4-8 Dec. 1989
(Contract DE-AC06-76RL-01830)
(DE90-004114; PNL-SA-17480; CONF-891204-7) Avail: NTIS HC A03/MF A01

The development of alloys with reduced long-life radioactivity has been incorporated into the goals of fusion materials development. One possible candidate alloy is Fe-12Cr-6.5Mn-1W-0.3V-0.1C, a manganese-stabilized martensitic steel. The phase stability of this steel has been investigated following neutron irradiation in the Fast Flux Test Facility at Richland, Washington, over a temperature range of 420 to 600 C to doses as high as 100 dpa. The microstructural response of the irradiated steel has been compared to that of the same alloy aged for 10,000 hours from 365 to 600 C. The only precipitate found following aging at 365 and 600 C was M23C6. After aging at 420 and 520 C, an Fe-Cr-Mn-W chi phase formed in addition to M23C6. After neutron irradiation, alpha prime and M23C6 formed at 420 C but only M23C6 was present at 600 C. At 520 C, M23C6 was still present, and the matrix consisted of a mixture of ferrite and the Fe-Cr-Mn-W chi phase observed in the aging study. The presence of chi phase in both the thermally aged and neutron irradiated steels indicates that the Fe-Cr-Mn alloy system is prone

to intermetallic phase formation so that careful study of the system and the effects of alloying are needed. DOE

N90-16915# Cornell Univ., Ithaca, NY.
ION BEAM MODIFICATION OF METALS: MECHANICAL PROPERTIES AND STRUCTURE Final Report, 15 Aug. 1986 - 14 Aug. 1989
E. L. Fleisher 1 Oct. 1989 9 p
(Contracts DAAL03-86-K-0063; N00014-87-K-0263)
(AD-A214701; ARO-23400.1-MS) Avail: NTIS HC A02/MF A01 CSCL 11/6

The phase transformations and property changes of metals bought about by ion beam induced materials modification was studied and this information was used to produce stable surface layers exhibiting optimal chemical and mechanical integrity. Summary of significant results: (1) Amorphous alloys can be formed by ion mixing a wide variety of metal systems within defined regions of atomic composition; (2) Two step processing such as implanting Carbon and Nitrogen into ion beam mixed layers improves the friction behavior; (3) Iron-Titanium mixed on stainless steel and implanted with N and C results in a wear resistant layer that deforms to depths greater than the thickness of the modified layer; (4) These novel structures on stainless steel were used to demonstrate a technique for distinguishing between deformation and material removal on worn surfaces; and (5) Mixing substantial amounts of gold into Ti improves corrosion resistance of the Ti without appreciably degrading the wear and friction behavior. GRA

N90-16916# Pennsylvania Univ., Philadelphia. Dept. of Materials Science and Engineering.
EXPERIMENTAL EVALUATION OF NEW ALLOY COATINGS Final Report, Nov. 1986 - Jan. 1989
Kang N. Lee and Wayne L. Worrell 19 Jul. 1989 51 p
(Contract F33615-86-C-5138)
(AD-A214922; WRDC-TR-89-4053) Avail: NTIS HC A04/MF A01 CSCL 11/6

The oxidation behavior of binary iridium aluminum and iridium and hafnium alloys, and ternary iridium aluminum silicon, rhenium aluminum silicon, tungsten aluminum silicon and molybdenum aluminum silicon alloys was investigated in 1 atm oxygen at 1550 to 1800 C. Iridium hafnium alloys form a protective hafnia scale at above 50 at percent hafnium and iridium aluminum alloys form a protective alumina scale at above 55 percent aluminum. Silicon decreases the aluminum concentration necessary for the formation of a protective alumina scale on irridium aluminum alloys from around 55 to below 30 at percent, and remarkably extends the lifetime of the alumina scale. Rhenium aluminum silicon, tungsten aluminum silicon, and molybdenum aluminum silicon alloys also exhibit good oxidation resistance, but the data are too sparse for any definite analysis or conclusions. The iridium aluminum silicon alloys with the aluminum concentration from 30 to 50 and the silicon concentration from 8 to 15 at percent are proposed to be the best potential coating materials. GRA

N90-16917# Army Materials Technology Lab., Watertown, MA. Materials Testing and Evaluation Branch.
FAILURE ANALYSIS OF A MISSILE LOCKING HOOK FROM THE F-14 JET Final Report
Victor K. Champagne, Jr. and Gary Wechsler Sep. 1989 59 p
Sponsored by Army Lab. Command, Adelphi, MD
(AD-A214995; MTL-TR-89-90) Avail: NTIS HC A04/MF A01 CSCL 11/6

A comprehensive metallurgical examination of the missile hook was conducted at the U.S. Army Materials Technology Laboratory (MTL) to determine the probable cause of failure. The component is one of two launcher housing support points for the Sparrow Missile and is located on the F-14 jet. The missile hook failed while in service. Chemical analysis verified that the part was fabricated from 300M steel. It was determined by metallographic examination that the microstructure was martensitic. Visual inspection and light optical microscopy of the load-bearing area showed that the surface coating Microlube had been completely worn away during service, allowing corrosion to take place. Extensive pitting was found on surface regions near the fracture. Further analysis of the Microlube coating revealed that required thickness specifications were exceeded. The machined radius where the fracture initiated was measured and found to be sharper than specified. The mechanical properties of the material compared favorably with requirements. Scanning electron microscopy (SEM) and energy dispersing spectroscopy (EDS) were used to characterize the fracture surface and the surface coatings. The entire manufacturing history of the missile hook was conducted in order to calculate the operating stresses, the critical crack size, and the critical stress intensity factor (KIC) for the conditions observed. The failure was attributed to a fatigue crack that had initiated at the base of an undercut radius on the machined lip of the component. GRA

N90-16918# Martin Marietta Aerospace, Denver, CO.
DEVELOPMENT OF A RELIABLE FABRICATION TECHNIQUE TO PRODUCE INTERMETALLIC COMPOUNDS
1989 6 p
(Contract N00014-85-C-0857)
(AD-A215004; MCR-85-721) Avail: NTIS HC A02/MF A01 CSCL 11/6

Intermetallic compounds offer very high specific material properties and property retention at elevated temperatures. However, reliable processing techniques to fabricate these materials have not been developed. This program investigates the use of a novel fabrication technique involving a deformation-solid state reaction bonding process to form titanium beryllides. The objectives are to: Establish reaction kinetics for the formation of titanium beryllides (Ti-Be) intermetallic compounds; Establish processing parameters needed to reproducibly fabricate these materials; Characterize the properties of titanium beryllides fabricated using a deformation-solid state reaction bonding process; Investigate the effects that alloying additions have on the crystal structure of titanium beryllides; and Determine how changes impact the beryllide's mechanical properties. GRA

N90-16919# Department of the Navy, Washington, DC.
ALLOYING OF METALS FOR CORROSION RESISTANCE Patent Application
Edward McCafferty, inventor (to Navy), Graham K. Hubler, inventor (to Navy), and Paul M. Natishan, inventor (to Navy) 29 Sep. 1989 19 p
(AD-D014313; US-Patent-Appl-SN-414223) Avail: NTIS HC A02/MF A01 CSCL 11/6

The corrosion resistance of bulk metals is improved by implanting a corrosion-resistant species into the surface of the bulk metal in a layer beginning at the surface and extending to a depth of at least about 50 angstroms. An amount of corrosion-resistant species is deposited so that the oxide layer that forms on the corrosion-resistant species implanted bulk metal is composed of at least about three percent of the oxide of the corrosion-resistant species. GRA

N90-16920# SRI International Corp., Menlo Park, CA.
EVALUATION OF A DIFFUSION/TRAPPING MODEL FOR HYDROGEN INGRESS IN HIGH STRENGTH ALLOYS Annual Report, Nov. 1988 - Nov. 1989
Bruce G. Pound 17 Nov. 1989 51 p
(Contract N00014-86-C-0233)
(AD-A215528) Avail: NTIS HC A04/MF A01 CSCL 11/6

The ingress of hydrogen in three precipitation-hardened alloys (Inconel 718, Incoloy 925, and 18Ni maraging steel) and titanium (pure and grade 2) was studied using a potentiostatic pulse technique. Anodic current transients were obtained for these materials in an acetate buffer (1 mol L-i HAc/1 mol L-1 NaAc where Ac = acetate). The data for the Ni-containing alloys and Ti grade 2 were shown to fit a diffusion/trapping model under interface control, and values were determined for the irreversible trapping constants (k) and the flux of hydrogen into the alloys. The absence of hydrogen ingress in the case of pure titanium

indicates that the surface oxide is an effective barrier to hydrogen entry. GRA

N90-16921# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
THE SUBSTITUTION OF IVD (ION VAPOR DEPOSITION) ALUMINUM FOR CADMIUM Final Report, Feb. 1988 - Jan. 1989
V. L. Holmes, D. E. Muehlberger, and J. J. Reilly Aug. 1989 201 p Prepared in cooperation with McDonnell Aircraft Co., St. Louis, MO
(Contract DE-AC07-76ID-01570; AF Proj. 2103)
(AD-A215633; ESL-TR-88-75) Avail: NTIS HC A10/MF A01 CSCL 11/3

The United States Air Force (USAF) is concerned about the use of toxic processing at the Air Logistics Centers (ALCs). To reduce hazardous waste generation from cadmium electroplating, McDonnell Aircraft Division (MCAIR) of McDonnell Douglas, through EG and G Idaho, was requested to determine the feasibility of substituting ion vapor deposition (IVD) of aluminum, across the board, for cadmium electroplating processes. The IVD aluminum coating and process does not generate hazardous wastes. The current phase of this contract required technical, environmental, and economical comparisons between IVD of aluminum and cadmium electroplating. This report provides that information. Recommended research and development to be conducted in Phase 2 of the contract is also included. GRA

N90-16922# Los Alamos National Lab., NM.
MIGRATION OF CARBON IN TEMPERED MARTENSITIC STEEL DURING EXCIMER LASER MELTING
Juha-Pekka Hirvonen, Thomas Roland Jervis, and Thomas George Zocco 1989 6 p Presented at the Materials Research Society Fall Meeting, Boston, MA, 27 Nov. - 2 Dec. 1989
(Contracts W-7405-eng-36; DEW-88-24)
(DE90-004838; LA-UR-89-4083; CONF-891119-54) Avail: NTIS HC A02/MF A01

The migration of ion implanted C-13 in tempered martensitic steel (nominal composition 1.05 wt. percent C, 0.2 wt. percent Si, and 0.3 wt. percent Mn) during excimer laser melting was examined utilizing the resonance of the C-13(p,gamma)N-14 reaction at Ep = 1747.6 keV. Depth concentration profiles after five and ten laser pulses of 1 J/sq cm revealed deviation from random walk diffusion in a homogeneous media. This was modelled by using the solubility controlled flow of carbon in iron-carbon melt. A diffusion length of 2 times the square root of d tau 34 + or - 2 nm during a period, tau, of the melted phase was deduced. Significant amorphous to crystalline transformation occurred during the rapid self quenching following laser melting. DOE

N90-16923# Massachusetts Univ., Amherst. Dept. of Chemistry.
THEORY OF THE DISSOCIATION DYNAMICS OF SMALL MOLECULES ON METAL SURFACES: FINITE TEMPERATURE STUDIES Progress Report, 1 Jul. 1987 - 30 Jun. 1990
Bret E. Jackson Dec. 1989 6 p
(Contract DE-FG02-87ER-13744)
(DE90-005217; DOE/ER-13744/9) Avail: NTIS HC A02/MF A01

Much can be learned about metal catalyzed reactions from studies of dissociative adsorption. A proper theoretical treatment of this process was hindered by the difficulty of including all important molecular degrees of freedom, as well as the thermal fluctuations of the solid, in a quantum reactive scattering calculation. We began our project by implementing the first quantum mechanical study of H2 dissociation on a metal. Using a two dimensional model, the dissociation probability was computed as a function of beam energy, molecular mass, and the shape of the interaction potential. A powerful and versatile time dependent method was used to describe the molecular wave function. Techniques were developed for introducing temperature into these calculations. The vibrations of the metal are treated quantum mechanically, and the method works well for both heavy and light molecules. In order to test the approach it was successfully applied to several non-reactive gas-surface scattering problems. Six dimensional models for the dissociative adsorption of diatomics were devised, which treat rotation, vibration/dissociation, and translation perpendicular to the surface quantum mechanically. The other variables are included semiclassically. A complete finite temperature study of several reactive diatom-metal systems is in progress. DOE

N90-16924# Sandia National Labs., Albuquerque, NM.
STRENGTHENING OF ALUMINUM BY OXYGEN IMPLANTATION: EXPERIMENTAL RESULTS AND MECHANICAL MODELING
Roy J. Bourcier, David M. Follstaedt, Samuel M. Myers, and Douglas H. Polonis (Washington Univ., Seattle.) 1989 6 p Presented at the 1989 Materials Research Society Fall Meeting, Boston, MA, Oct. 1989
(Contract DE-AC04-76DP-00789)
(DE90-005960; SAND-89-3050C; CONF-8910336-2) Avail: NTIS HC A02/MF A01

The microstructure and mechanical properties of high purity aluminum implanted with 20 at. percent oxygen to a depth of roughly 500 nm and subjected to various thermal histories have been examined. Transmission electron microscopy and Rutherford-backscattering spectrometry were used to characterize the depth and nature of the implanted zone. As implanted, the material appears to contain a homogeneous distribution of disordered precipitates with sizes of 1.5 to 3.5 nm. Annealing at 450 or 550 C/1 hr induces ordering of the precipitates but only causes slight coarsening. Ultra-low load identation hardness testing was used to probe the mechanical response of the surface-modified material. The data from the hardness tests were interpreted through the use of a finite-element model; the results indicate the flow stresses of an implanted and annealed layer are as high as 1600 MPa. The as-implanted material is much harder, approaching 3300 MPa. The degree of strengthening expected for the as-implanted and post-annealed material on the basis of the observed microstructure was estimated using several micromechanical models, and the results conform to the findings from indentation testing. DOE

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials*.

N90-16925*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
POLYCARBONATE ARTICLE WITH CHEMICAL RESISTANT COATING Patent Application
Joseph J. Kosmo, inventor (to NASA) and Frederic S. Dawn, inventor (to NASA) 30 Nov. 1989 10 p
(NASA-Case-MSC-21503-1; NAS 1.71:MSC-21503-1; US-Patent-Appl-SN-443414) Avail: NTIS HC A02/MF A01 CSCL 11C

An article of laminate construction is disclosed which is comprised of an underlayer of polycarbonate polymer material to which is applied a chemically resistant outer layer of polysulfone. The layers which are joined by compression-heat molding, are molded to form the shape of a body protective shell such as a space helmet comprising a shell of polycarbonate, polysulfone laminate construction attached at its open end to a sealing ring adapted for connection to a space suit. The front portion of the shell provides a transparent visor for the helmet. An outer visor of polycarbonate polysulfone laminate construction is pivotally mounted to the sealing ring for covering the transparent visor portion of the shell during extravehicular activities. The polycarbonate under layer of the outer visor is coated on its inner surface with a vacuum deposit of gold to provide additional thermal radiation resistance. NASA

N90-16926*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
LARC-IA: A FLEXIBLE BACKBONE POLYIMIDE
Donald J. Progar and Terry L. StClair Jan. 1990 39 p
(NASA-TM-102586; NAS 1.15:102586) Avail: NTIS HC A03/MF A01 CSCL 11C

A new linear, aromatic, thermoplastic polyimide, prepared from oxydiphthalic anhydride (ODPA) and 3,4'-oxydianiline (ODA) in diglyme and identified as LARC-IA, was synthesized and evaluated. The monomers are relatively inexpensive and physiologically safe. Molecular weight was controlled by use of a monofunctional anhydride, phthalic anhydride (PA), in order to promote controlled flow and wetting properties. The polymer is considered a safe alternative to commercially available LARC-TPI which is prepared with an expensive diamine of uncertain carcinogenicity. The evaluation was based primarily on the polymer's adhesive properties as determined by thermal and water boil exposure of lap shear specimens. Strengths were determined at room temperature, 177, 204 and 232 C before and after exposure to determine the adhesive system's durability to adverse environments over a period of time. Other properties (FWT, G(1c), film and composite properties) were examined which were determined to be typical of a high temperature polyimide. Results of the study show a favorable comparison to LARC-TPI, a commercially available polyimide. Author

N90-16927# Oak Ridge Y-12 Plant, TN.
COMPOUND FOR METALLIC SURFACE TREATMENT
Hishshi Suzuki (Shikoku Chemical Research Industries, Inc., Ibaragi, Japan) 1989 5 p Transl. into ENGLISH of Japanese Patent Application No. 57-161068 (4 Oct. 1982)
(Contract DE-AC05-84OR-21400)
(DE90-004121; Y/TR-89/9) Avail: NTIS HC A01/MF A01

This invention concerns a compound for use in a treatment that significantly improves the durability of a metallic surface, in particular one with high mirror reflection. The present invention assumes that it is possible to protect the metallic surface by means of a treatment aimed at improving durability, attained through the inorganic nature of the compound; additionally, improved surface durability helps protect the metal itself and enhance corrosion resistance. DOE

N90-16928# Government Industrial Research Inst., Osaka (Japan).
BASIC STUDIES ON SEPARATIVE GLASS
Tents Yazawa 25 Mar. 1989 242 p In JAPANESE; ENGLISH summary
(DE90-702436; GIRIO-8901) Avail: NTIS (US Sales Only) HC A11/MF A02

The interaction between the surface of porous glass prepared by phase separation method and substance which permeates the surface, and the application of the interaction to the separation of substances are introduced. Separation of substances using membrane is now appearing in the limelight from the view point of energy saving. Development of membrane materials with excellent permeability is inevitable for the materialization of membrane separation process. Borosilicate glass shows a remarkable phase separation phenomenon, and the phase separated glass becomes silica glass by acid treatment. The obtained porous glass membrane has better formability than ceramics. Development of glass materials having the characteristics for membrane separation is discussed. Then, methods for improving the surface of pores on porous glass by varying pore diameters, and the physical properties of the improved porous glass are investigated. Separation of substance and analysis of permeation mechanism were carried out using the glass as the membrane. Application of catalyst supported porous glass to a membrane reactor is also introduced. DOE

N90-16929# New Energy Development Organization, Tokyo (Japan).
STUDY OF THE EFFECT OF CERAMICS GAS TURBINE DEVELOPMENT
Mar. 1988 182 p In JAPANESE; ENGLISH summary
(DE90-702638; NEDOJ-P-8723) Avail: NTIS (US Sales Only) HC A09/MF A02

The result of the studies made, under contract awarded by the HEDO, on the effect of ceramic gas turbine (CGT) development has been edited in this report. The gas turbine is an ideal prime mover which satisfies requirements of the Japanese energy policy, with the ability to use various kinds of fuel. It has many strong features such as light weight, small size, exhaust gas with little pollutant, low noise, little vibration, etc. The only bad point is its low thermal efficiency. If ceramic, an excellent heat resisting material, is used for CGT, the thermal efficiency of the engine can be theoretically improved to become more than 40 percent. Developments of CGT have been actively pursued in the advanced countries in Europe and America, supported by the governments. Fundamental problems concerning CGT were studied and evaluated. Investigations and evaluations were made on the marketability and the effect of the product on the possibility of application to other industries and technological areas. The effect of CGT development on the economical and social environments in Japan was studied. DOE

N90-16930# National Centre of Tribology, Risley (England).
ADVANCED TRIBOLOGICAL COATINGS FOR HIGH SPECIFIC STRENGTH ALLOYS Interim Report No. 5
M. K. Vine 29 Sep. 1989 121 p
(Contract DAJA45-87-C-0044)
(AD-A214061; NCT-3789/607; R/D-5876-MS-01) Avail: NTIS HC A06/MF A01 CSCL 11/3

The objective of this contract is to develop and test a surface treatment suitable for the hardening of a titanium alloy precision gear for use in a vacuum environment. Attention has been primarily directed at surface hardening by the interstitial diffusion of the elements nitrogen, oxygen and carbon. Targets of a surface hardness of greater than 500 HV and depth 50 microns, without the need of any post heat treatment operations have been identified. The surface treatments under study have been applied to specimens of IMI 318 (Ti6Al4V), cut from plate. The sample numbers and corresponding surface treatments which have been carried out and tested to date are listed in Table 1. SHT indicates that the plates sample was in a solution heat treated condition before surface treatment. H and G indicates that the sample was in a hardened and ground condition before surface treatment. GRA

N90-16931# California Univ., Los Angeles. Dept. of Chemistry and Biochemistry.
CHEMICAL-LIKE BEHAVIOR OF ELECTRONS AND HOLES IN POLYMERIC CONDUCTORS Final Report, 1 May 1986 - 30 Apr. 1988
Howard Reiss 28 Sep. 1989 49 p
(Contract F49620-86-C-0060; AF Proj. 2303)
(AD-A214496; AFOSR-89-1289TR) Avail: NTIS HC A03/MF A01 CSCL 07/6

Research is reported on the use of thermodynamically reversible dopant solubilities (and electro-solubilities), in conducting polymers, for the study of ionization mechanisms, band structures, and carrier species. Both theory and experiment is accomplished. Much work is focused on iodine in polythiophene and protons in emeralsine. Studies of conducting polymer film as gas selective membranes are performed. The results are dramatic; conducting polymers appear to be exceptionally good gas selective membranes. GRA

N90-16932# Du Pont de Nemours (E. I.) and Co., Wilmington, DE. Dept. of Central Research and Development.
SYMPOSIUM ON CHEMICAL PRECURSORS TO CERAMICS Final Report
Fred N. Tebbe, Uma Chowdhry, and John D. Bolt 12 Sep. 1989 15 p Symposium held in Miami Beach, FL, 12 Sep. 1989 Sponsored in part by American Chemical Society, Washington, DC
(Grant AF-AFOSR-0448-89; AF Proj. 2303)

(AD-A214499; AFOSR-89-1355TR) Avail: NTIS HC A02/MF A01 CSCL 11/2

It was the purpose of the Symposium on Chemical Precursors to Ceramics to promote exchange of information among chemists and materials scientists engaged in studies related to the chemistry of materials. Participants were chosen to represent perspectives of industrial, academic, and national laboratories. GRA

N90-16933# Pennsylvania State Univ., University Park. Materials Research Lab.

CRYSTALLIZATION OF NANOCOMPOSITE GLASSES MADE BY THE SSG PROCESS Report, 1 Sep. 1988 - 31 Aug. 1989

Rustum Roy and Sridhar Komarneni 31 Aug. 1989 87 p

(Contract F49620-88-C-0134)

(AD-A214572; AFOSR-89-1348TR) Avail: NTIS HC A05/MF A01 CSCL 11/2

The phenomenon of solid state epitaxy is examined. The first goal of the current research is to explore the role of solid state epitaxy in the crystallization of a very much wider range of glass composition to make glass ceramics. The nanocomposite xerogel route is being utilized to attempt to make a universal glass-ceramic with controllable crystallization. Isostructural seeding of cordierite glass led to a lowering in crystallization temperature due to epitaxy just as in the nucleated crystallization of ceramics. Experiments with other system such as lithium aluminum silicate and lithium aluminum disilicate are in progress and preliminary results show that solid state epitaxy is lowering the crystallization temperatures. The second area of current research is to extend the validity of solid state epitaxy proven by the growth of alumina films of alpha AL2O3 single crystals is being extended to other oxides, metals and semiconductors. Epitaxial crystallization of silicon (oxy)carbide glasses such as Nicalon compositions is being investigated in addition to the oxide glasses and gels. GRA

N90-16934# Moltech Corp., Shoreham, NY.

PLASMA ASSISTED CHEMICAL VAPOR DEPOSITION OF DIAMOND FILMS

Arun R. Srivatsa 7 Nov. 1989 5 p

(Contract N00014-89-C-0212)

(AD-A214641) Avail: NTIS HC A01/MF A01 CSCL 20/12

The status is described of the program on plasma enhanced CVD of diamond and diamondlike films. Using electron cyclotron resonance (ECR), a dense microwave plasma is formed in a cylindrical Lisitano coil at low power (70 to 80W) and low pressures (.001 to .0001 Torr). The purpose of this study is to investigate the direct and remote plasma production of diamond and diamondlike films using a unique geometry permitting very good spatial confinement of the plasma. By varying the geometry of the Lisitano coil, dense plasmas can also be produced at higher pressures. GRA

N90-16935# National Inst. for Higher Education, Limerick (Ireland).

THE PREPARATION AND CHARACTERISATION OF OXYNITRIDE GLASSES AND GLASS-CERAMICS Final Report

Stuart Hampshire Jul. 1989 96 p

(Contract DAJA45-85-C-0050; DA Proj. 1L1-61103-BH-57)

(AD-A214783; R/D-4881-MS-01) Avail: NTIS HC A05/MF A01 CSCL 11/2

The objective was to study the effect on properties (such as microhardness, glass transition, crystallization temperature, viscosity, etc.) of replacing oxygen by nitrogen in sialon-based glasses containing rare earth cations and to study the formation of glass-ceramics by controlled crystallization of these oxynitride glasses and to assess the effects of this on properties. Glasses were prepared by melting appropriate oxides and nitrides in boron nitride lined crucibles, melting at 1700 C under nitrogen and casting into preheated graphite moulds followed by annealing. Characterization of the glasses was carried out by differential thermal analysis (DTA) to ascertain the glass transition and crystallization temperatures and standard techniques used for microhardness and viscosity. Nitrogen increases the glass transition, microhardness and viscosity for constant cation ratio glasses and also inhibits crystallization. From DTA, suitable heat treatment schedules were designed to produce fine grain glass-ceramics. Optimization of these heat treatments was by measuring the changes (increases) in microhardness. Fully amorphous glasses can be prepared easily in large batches (approx. 100g) in many M-Si-Al-O-N systems. Work concentrated on Neodynium and Y-sialon glasses which undergo homogeneous nucleation at Tg+50 C followed by crystal growth at Tc-40 C each for 2.5 hours. GRA

N90-16936# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.

THE FUTURE OF AIRCRAFT PAINT REMOVAL METHODS M.S. Thesis

Michael J. Then Sep. 1989 169 p

(AD-A214946; AFIT/GLM/LSM/89S-67) Avail: NTIS HC A08/MF A01 CSCL 11/11

The purpose of this study was to develop a qualitative forecast for predicting aircraft paint removal methods. A Delphi methodology was used to create a technical forecast, combining the expectations of individuals who work with the related technologies on a daily basis. The Delphi results yielded five major conclusions. First, the projected paint removal method that will suit future paint removal needs is Plastic Media Blasting (PMB), and no other method is projected to be a serious threat to PMB's dominance. Second, PMB's process and parameters must be further researched to optimize the method's effectiveness. Third, the worker's safety can be further enhanced by both protective equipment that is available today, and facility construction that is specifically designed for the given removal method. Fourth, facility design is the major consideration when defining a paint removal's environmental effects. Lastly, it is undeterminable if robotics will replace human labor. Equipment that safely applies PMB is available today, while the equipment that further the method's effectiveness of separating heavy particles will be acessible in 1 year. GRA

N90-16937# Rensselaer Polytechnic Inst., Troy, NY.

THE REDETERMINATION OF THE ELASTIC, PIEZOELECTRIC, AND DIELECTRIC CONSTANTS OF QUARTZ AND THEIR VARIATION WITH TEMPERATURE Final Technical Report, Feb. 1984 - Feb. 1987

H. F. Tiersten Aug. 1989 49 p

(Contract F19628-84-K-0004; AF Proj. 2305)

(AD-A215025; RADC-TR-89-112) Avail: NTIS HC A03/MF A01 CSCL 20/3

The redetermination of the elastic, piezoelectric and dielectric constants of quartz and the temperature derivatives of the effective constants is studied. Analyses are presented for both thickness excitation and lateral excitation of pure thickness vibrations, and the results are specialized to doubly-rotated, singly-rotated an unrotated cuts of quartz. It is shown that all elastic constants can be obtained from measurements using lateral excitation of unrotated cuts and one rotated y-cut. Simple relations are provided for the determination of the piezoelectric and dielectric constants from the measurement of the fundamental and third harmonic resonant frequencies of thickness excited thickness vibrations. An analysis for the perturbation of pure thickness vibrations is presented for both the cases of thickness excitation and lateral excitation, and the results are specialized to doubly-rotated, singly-rotated and unrotated cuts of quartz. GRA

N90-16938# Army Materials Technology Lab., Watertown, MA. Ceramics Research Branch.

FRACTOGRAPHIC ANALYSIS OF LONG ROD PENETRATOR-ARMOR CERAMIC INTERACTIONS Final Report

Michael J. Slavin Oct. 1989 21 p Presented at the 5th TACOM Armor Coordinating Conference, 7-9 Mar. 1989

(DA Proj. 1L1-62105-AH-84)

(AD-A215172; MTL-TR-89-93) Avail: NTIS HC A02/MF A01 CSCL 19/4

The stages of armor ceramic fracture and defeat mechanisms of the projectile have been well documented for small caliber

rounds (.30 and .50 caliber ball and armor piercing). The recent ability to manufacture ceramic tiles capable of protecting vehicles against large caliber munitions has shifted research to incorporating these materials into ground systems. Though many studies are evaluating the relationship of processing, microstructure, and mechanical properties with ballistic performance, few programs have focused on the actual defeat mechanisms involved for these heavy threats. A program was initiated to evaluate the fracture of a ceramic target when impacted by a tungsten long-rod penetrator (LRP). Following a conventional V50 test of a silicon carbide whisker-reinforced aluminum oxide, one target was serial sectioned from the rear. Very fine comminuted ceramic was painstakingly removed from the exit point of the LRP. Tungsten and steel particles were included in the ceramic powder. GRA

N90-16939# Naval Submarine Medical Research Lab., Groton, CT. Dept. of Biomedical Sciences.
ANALYSIS OF HYDRAULIC FLUIDS AND LUBRICATING OILS FOR THE FORMATION OF TRIMETHYLOLPROPANE PHOSPHATE (TMP-P) Final Report, Aug. 1985 - Apr. 1987
A. B. Callahan, D. V. Tappan, L. W. Mooney, and E. Heyder 9 Aug. 1989 97 p
(AD-A215188; NSMRL-SP89-5) Avail: NTIS HC A05/MF A01 CSCL 06/11

Twenty-six different oils, hydraulic fluids and lubricants in U.S. Navy inventory were screened for yield of the neurotoxin Trimethylolpropane phosphate (TMP-P) in order to obtain an estimate of safety hazard potential. A commercially available synthetic aircraft engine oil (Exxon 2380) with a demonstrated yield of TMP-P was studied to establish the optimal temperature and pyrolysis time conditions for TMP-P production. Results of the analysis indicate that in the Exxon 2380 synthetic oil, TMP-P is formed very rapidly (within 5 minutes) with formation beginning in a temperature range of 350 to 400 C. The yield of TMP-P increases as a function of temperature and achieves a maximum yield at 450 to 500 C. Above this temperature, the TMP-P yield decreases rapidly to zero at 600 C probably due to thermal decomposition. Only one of the twenty-six oils from the U.S. Navy inventory gave evidence of TMP-P formation. The maximum TMP-P yield of oil (MIL-L-23699C) was only 1.9 percent (120 ug/g) of the maximum yield (6241 ug/g) for the Exxon 2380 synthetic engine oil. Results obtained from three laboratories have been applied to an assessment of the hazard potential of pyrolyzed oils and lubricants assayed in this study. GRA

N90-16940# United Technologies Research Center, East Hartford, CT.
STUDY OF ADHERENT OXIDE SCALES Final Report, 1 Jan. - 30 Sep. 1989
John G. Smeggil 27 Oct. 1989 48 p
(Contract N00014-85-C-0421)
(AD-A215189; UTRC/R89-917259-2) Avail: NTIS HC A03/MF A01 CSCL 07/3

Previously reported studies had shown that indigenous sulfur normally present in the approximately 1 to 40 ppm range significantly affected the scale adherence of both alumina and chromia formers. In isothermal studies involving the oxidation of the model chromia former, Ni-40 wt. percent Cr, visual examination of alumina crucibles containing test specimens and subsequent analytical chemistry measurements showed that protective chromium oxides exhibited less volatility on high purity as compared to normal sulfur-containing alloys. While the absolute amount of chromium evaporated was small, higher purity (lower sulfur) alloys repeatedly showed less chromia volatilization. For cyclic tests involving sulfur-bearing (SO2-O2) environments, sulfur penetration of chromia scales occurred regardless of the purity of the alloy or whether or nor yttrium had been added to the normal purity alloy. GRA

N90-16941# Raytheon Co., Lexington, MA. Research Div.
HIGH MODULUS COATINGS Progress Report, 1 Oct. 1988 - 30 Sep. 1989
Randal W. Tustison 13 Oct. 1989 8 p
(Contract N00014-87-C-0251)
(AD-A215448) Avail: NTIS HC A02/MF A01 CSCL 11/3

Mechanisms are explored by which the ultimate fracture strength of ZnS can be increased without degrading it's optical transparency in the bandpass of interest. Relatively thin films of Y2O3 could be used to strengthen substrates of ZnS. The observed strengthening effect was shown to be related to the intrinsic compressive stresses in the film. The magnitude of the strengthening is relatively independent of film thickness, deposition method (i.e., magnetron vs. ion beam sputtering) and even film composition, depending only on the sign of the film stress. For example, the strengthening effect was not observed in ZnS samples coated with evaporated YF3 films, wherein the intrinsic film stresses were found to be tensile. Ion assisted evaporation of the same material resulted in the creation of new compressive stresses and the substrate strengthening effect was again observed. In all cases the observed effect was found to be a 25 to 35 percent increase which is in agreement with a model wherein flaws originally residing at the surface of a brittle material like ZnS are internalized. GRA

N90-16942# Aeronautical Research Labs., Melbourne (Australia).
THERMOELASTIC RESPONSE OF AN EPOXY
R. W. Eustace Aug. 1989 19 p
(AD-A215639; ARL-STRUC-TM-519; DODA-AR-006-052) Avail: NTIS HC A03/MF A01 CSCL 11/9

An investigation was conducted into the thermoelastic response of an Epoxy subjected to a cyclic compressive loading. A SPATE 8000 detector is used to monitor the response as the mean stress, frequency and cyclic amplitude are varied individually. The response is briefly discussed with respect to the theoretical equation predicting the behavior of an isotropic Hookean material, and a measure of the Epoxy's mean stress dependence of the thermoelastic parameter is given. GRA

N90-16943# Akron Univ., OH. Polymer Engineering Center.
BLOW-OUT OF RUBBER BLOCKS DUE TO INTERNAL HEATING
A. N. Gent and M. Hindi Nov. 1989 19 p
(Contract N00014-85-K-0222)
(AD-A215730; TR-22) Avail: NTIS HC A03/MF A01 CSCL 11/10

Rubber blocks undergo explosive blowout when heated in a microwave oven. The process appears to be the same as the blowout caused by repeatedly applied, severe compressive loads. It is attributed to high internal pressures generated by a volatile product of thermal decomposition. Bursting took place at lower temperatures for softer compounds and for compounds that softened markedly upon heating. The blowout temperature was also quite different for different elastomers, being low for butyl over 200 C. Polybutadiene compounds did not blowout at all, probably because the products of thermal decomposition were less volatile. GRA

N90-16944*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THE EXPERIMENTAL EVALUATION AND APPLICATION OF HIGH-TEMPERATURE SOLID LUBRICANTS Ph.D. Thesis - Case Western Reserve Univ., 1989 Final Report
Christopher DellaCorte Jan. 1990 57 p
(Contract DE-AI01-85CE-50162)
(NASA-TM-102476; E-5263; DOE/NASA/50162-3; NAS 1.15:102476) Avail: NTIS HC A04/MF A01 CSCL 11C

A research program is described which developes an understanding of high-temperature solid lubrication and experimental techniques through the development of a composite lubricant coating system. The knowledge gained through this research was then applied to a specific engineering challenge, the tribology of a sliding seal for hypersonic flight vehicles. The solid lubricant coating is a chromium carbide based composite combined with silver, which acts as a low temperature lubricant, and barium fluoride/calcium fluoride eutectic, which acts as a

high-temperature lubricant. This composite coating provides good wear resistance and low friction for sliding contacts from room temperature to over 900 C in reducing or oxidative environments. The specific research on this coating included a composition screening using a foil gas bearing test rig and the use of thin silver films to reduce initial wear using a pin-on-disk test rig. The chemical stability of the materials used was also addressed. This research indicated that soft metallic films and materials which become soft at elevated temperatures are potentially good lubricants. The general results from the experiments with the model solid lubricant coating were then applied to a sliding seal design concept. This seal design requires that a braided ceramic fabric slide against a variety of metal counterface materials at temperatures from 25 to 850 C in an oxidative environment. A pin-on-disk tribometer was used to evaluate the tribological properties of these materials and to develop lubrication techniques. The results indicate that these seal materials must be lubricated to prevent wear and reduce friction. Thin films of silver, gold and calcium fluoride provided lubrication to the sliding materials.

Author

N90-16945# Oak Ridge National Lab., TN.
NOVEL APPROACH FOR HIGH RESOLUTION TEM (TRANSMISSION ELECTRON MICROSCOPY) STUDIES OF CERAMIC-CERAMIC INTERFACES

Abhaya K. Datye, Robert T. Paine, Chaitanya K. Narula (New Mexico Univ., Albuquerque.), and Lawrence F. Allard 1989 7 p Presented at the Spring Meeting of the Materials Research Society, San Diego, CA, 24-28 Apr. 1989
(Contract DE-AC05-84OR-21400)
(DE90-005272; CONF-890426-33) Avail: NTIS HC A02/MF A01

Ceramic coatings on oxides can be studied by high resolution transmission electron microscopy (HRTEM), with minimal sample preparation, if the substrate consists of nonporous particles of simple geometric shape. Interfaces suitable for end-on examination by HRTEM can be readily obtained without any necessity for ion-beam thinning. All the interface orientations that are thermodynamically stable are available for examination from a single sample. This technique is of general applicability and can be used for studies of metal-ceramic and ceramic-ceramic interfaces. We have examined the nature of boron nitride interfaces with oxides such as MgO, TiO2 and Al2O3 and find that BN appears to wet the oxide surface and form tough, adherent coatings. The hexagonal crystalline BN grows with the (0001) planes always being locally parallel to the oxide surface in every instance.

DOE

N90-16946# Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil). Dept. de Metallurgia Nuclear.
ZIRCONIA BASED CERAMICS

Jose Carlos Bressiani and Ana Helena de Almeid Bressiani May 1989 16 p In PORTUGESE
(DE90-606358; IPEN-PUB-253) Avail: NTIS (US Sales Only) HC A03/MF A01

Within the new generation of ceramic materials, zirconia continues to attract ever increasing attention by virtue of its singular combination of properties and being able to perform thermo-mechanical, electroelectronic, chemico-biological functions. Nevertheless, in order to obtain these properties, a through understanding of the phase transformation mechanisms and microstructural changes is necessary. This paper discusses the main parameters that require control during fabrication of these materials to obtain desired properties for a specific application.

DOE

N90-16947# Argonne National Lab., IL. Materials and Components Technology Div.
ADHESION OF SILVER FILMS TO ION-BOMBARDED ALUMINA

R. A. Erck and G. R. Fenske Dec. 1989 12 p Presented at the Materials Research Society Fall Meeting, Boston, MA, 27 Nov. - 2 Dec. 1989
(Contract W-31-109-eng-38)
(DE90-005642; CONF-891119-68) Avail: NTIS HC A03/MF A01

Silver films were deposited on alumina substrates using ion bombardment. Adhesion strength was measured as a function of deposition conditions, sputter-cleaning time, and bombarding ion species, using a pull-type adhesion tester. Argon- and argon/oxygen-ion sputtering produced large increases in adhesion strength, with the greatest increases occurring for oxygen-ion bombardment. Adhesion strength increased monotonically as a function of ion sputtering time. At a given deposition rate, further enhancement of adhesion is seen with concurrent ion bombardment.

DOE

N90-16948# Argonne National Lab., IL. Materials Science Div.
EROSION OF CERAMIC COMPOSITES BY VARIOUS ERODENTS

J. L. Routbort, C.-Y. Chu, J. M. Roberts, J. P. Singh, W. Wu, and K. C. Goretta Dec. 1989 16 p Presented at the 4th Berkeley International Conference on Erosion-Corrosion-Wear of Materials at Elevated Temperatures, Berkeley, CA, 31 Jan. - 2 Feb. 1990
(Contract W-31-109-eng-38)
(DE90-005650; CONF-900107-1) Avail: NTIS HC A03/MF A01

Solid-particle erosion has been measured in several ceramic matrix whisker-reinforced composites: Al sub 2 O sub 3 + SiC(w), Si sub 3 N sub 4 + Si sub 3 N sub 4 (w) and 3 mol percent Y sub 2 O sub 3 -stabilized zirconia + Al sub 2 O sub 3 (w). The steady-state erosion rate was investigated for normal incidence with an impact velocity of 100 m/s using four types of erodents with varying hardness. Steady-state erosion rate depends on the type of erodent, with the rate being fastest for the hardest particles. Whisker reinforcement of the ceramic matrix increases the fracture toughness, but does not, in all cases, increase the erosion resistance. Microstructural details also play an important role in determination of erosion resistance.

DOE

N90-16949* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
CELLULAR THERMOSETTING FLUORODIEPOXIDE POLYMERS Patent

Sheng Y. Lee, inventor (to NASA) 27 Jun. 1989 5 p
(NASA-Case-GSC-13008-2; US-Patent-4,843,123;
US-Patent-Appl-SN-163928; US-Patent-Class-521-178;
US-Patent-Class-521-82; US-Patent-Class-521-97;
US-Patent-Class-521-98; US-Patent-Class-521-145;
US-Patent-Class-521-189) Avail: U.S. Patent and Trademark Office CSCL 11C

Thermosetting fluoropolymer foams are made by mixing fluid form thermosetting fluoropolymer components having a substantial fluorine content, placing the mixture in a pressure tight chamber, filling the chamber with a gas, at relatively low pressure, that is unreactive with the fluoropolymer components, allowing the mixture to gel, removing the gelled fluoropolymer from the chamber and thereafter heating the fluoropolymer at a relatively low temperature to simultaneously sure and foam the fluoropolymer. The resulting fluoropolymer product is closed celled with the cells storing the gas employed for foaming. The fluoropolymer resins employed may be any thermosetting fluoropolymer including fluoroepoxies, fluoropolyurethanes and fluoroacrylates.

Official Gazette of the U.S. Patent and Trademark Office

N90-16950* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
COPOLYIMIDE WITH A COMBINATION OF FLEXIBILIZING GROUPS Patent

Terry L. StClair, inventor (to NASA), Harold D. Burks, inventor (to NASA), and Donald J. Progar, inventor (to NASA) 6 Jun. 1989 11 p
(NASA-Case-LAR-13821-1; US-Patent-4,837,300;
US-Patent-Appl-SN-071686; US-Patent-Class-528-353;
US-Patent-Class-524-233; US-Patent-Class-524-366;
US-Patent-Class-524-378; US-Patent-Class-524-600;

US-Patent-Class-524-607; US-Patent-Class-528-125) Avail: U.S. Patent and Trademark Office CSCL 11C

Copolyimides are prepared by reacting one or more aromatic dianhydrides with a meta-substituted phenylene diamine and an aromatic bridged diamine. The incorporation of meta-substituted phenylene diamine derived units and bridged aromatice diamine derived units into the linear aromatic polymer backbone results in a copolyimide of improved flexibility, processability, and melt-flow characteristics. The copolyimides are especially useful as thermoplastic hot-melt adhesives.

Official Gazette of the U.S. Patent and Trademark Office

N90-16840# Societe Europeenne de Propulsion, Vernon (France).
HIGH-PERFORMANCE LO2-CH4 ENGINE WITH CERAMIC MATRIX COMPOSITE MATERIALS
Andre Beaurain and C. Bonniot *In* ESA, Progress in Space Transportation Aug. 1989 p 469-47 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

N90-17098*# Ohio State Univ., Columbus. Dept. of Ceramic Engineering.
AGGLOMERATION OF CERAMIC POWDERS
James D. Cawley, Judith LaRosa, and Fredrick Dirkse *In* NASA, Lewis Research Center, NASA Laser Light Scattering Advanced Technology Development Workshop, 1988 Aug. 1989 p 185-197 (For primary document see N90-17085 09-35)
Avail: NTIS HC A14/MF A02 CSCL 11C

N90-17101*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
POLYMER SOLUTION PHASE SEPARATION: MICROGRAVITY SIMULATION
Lawrence C. Cerny (Utica Coll., NY.) and James K. Sutter *In its* NASA Laser Light Scattering Advanced Technology Development Workshop, 1988 Aug. 1989 p 229-234 (For primary document see N90-17085 09-35)
Avail: NTIS HC A14/MF A02 CSCL 11C

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N90-16951# Burns and Roe Services Corp., Pittsburgh, PA.
PRODUCTION OF JET FUELS FROM COAL DERIVED LIQUIDS. VOLUME 10: JET FUELS PRODUCTION BY-PRODUCTS, UTILITY, AND SULFUR EMISSIONS CONTROL INTEGRATION STUDY Interim Report, 1 May 1988 - 1 Apr. 1989
R. J. Rossi and D. A. Huber Jun. 1989 109 p
(Contract FY1455-86-N-0657; AF Proj. 2480)
(AD-A213872; AFWAL-TR-87-2042-Vol-10) Avail: NTIS HC A06/MF A01 CSCL 21/4

The potential of jet fuel production from the liquid by-product streams produced by the gasification of lignite at the Great Plains Gasification Plant (GPGP) in Beulah, North Dakota, was investigated. The results are reported of the effort by Burns and Roe Services Corporation/Science Applications International Corporation (BRSC/SAIC) to evaluate the impact of integrating Jet Fuel and/or Chemical Production Facilities with the Great Plains Gasification Plant. GRA

N90-16952# Ballistic Research Labs., Aberdeen Proving Ground, MD.
ANALYSIS OF LIQUID PROPELLANT EXPOSED TO ELASTOMERIC MATERIALS Memorandum Report, Sep. 1988 - Apr. 1989
Josephine Q. Wojciechowski, Sharon L. Taylor, and Wanda J. Olszewski Dec. 1989 22 p
(AD-A214465; BRL-MR-3800) Avail: NTIS HC A03/MF A01 CSCL 21/9

The Army is investigating use of LP in large and medium caliber guns. The propellant of primary interest is LPG 1846 consisting of hydroxylammonium nitrate, triethanolammonium nitrate and water. One of the concerns with fielding a liquid propellant system is compatibility with materials used for storage, transfer and handling. The Belvoir Research Development and Engineering Center undertook an investigation on the compatibility of elastomers with LPG 1846. The propellant was collected after exposure to the materials and sent to the Ballistic Research Laboratory for analysis. It was analyzed for a change in fuel and oxidizer content. This report is a compilation of the analysis. GRA

N90-16953# Army Armament Research, Development and Engineering Center, Picatinny Arsenal, NJ. Armament Engineering Directorate.
EFFECT OF REDUCED ATMOSPHERIC PRESSURE ON THE PERFORMANCE CHARACTERISTICS OF PYROTECHNIC COMPOSITIONS CONTAINING ALUMINUM
Patricia L. Farnell, Clement Campbell, and Francis R. Taylor Nov. 1989 28 p
(AD-A214473; ARAED-TR-89024) Avail: NTIS HC A03/MF A01 CSCL 19/1

A study of aluminum containing compositions shows that the burning time is greatly increased at simulated high altitude and reduced pressure. Since compositions using the same oxidants but using magnesium as the fuel are not similarly affected, it appears that the use of aluminum is definitely the cause of the increase. Removal or disruption of the oxide coating on the aluminum does not correct the problem. Use of air, argon, helium, or oxygen as the atmospheric gas shows that the problem occurs at or near the burning surface not in the atmosphere. Use of the different fuels demonstrates that the presence or absence of a protective oxide coating does not have an effect; however, the burning time is increased for compositions with high boiling fuels and relatively unaffected for those with low boiling fuels. Since the temperature of reaction is higher than the boiling point for low boiling fuels and lower for high boiling ones, the increase is caused by removal of heat from the surface by increased vaporization of high boiling fuels at low pressure. GRA

N90-16954# Coordinating Research Council, Inc., Atlanta, GA.
CRC (COORDINATING RESEARCH COUNCIL) OCTANE NUMBER REQUIREMENT SURVEY 1988
Aug. 1989 165 p
(Contract DAAK70-89-C-0022)
(AD-A214845; CRC-566) Avail: NTIS HC A08/MF A01 CSCL 21/4

An annual statistical survey of octane number requirements of current model vehicles is conducted by the Coordinating Research Council, Inc. Test data have been obtained by nineteen companies on 391 1988 vehicles including passenger cars and light-duty trucks and vans, of which 155 were equipped with knock sensors. Maximum octane number requirements were determined by testing at maximum-throttle conditions, as well as at part-throttle, with three unleaded fuel series of varying sensitivities. Requirements are expressed as the (R+M)/2 octane number, Research octane number, and Motor octane number of the reference fuel producing knock which was recurrent and repeatable at the lowest audible level. Estimated octane number requirements for the total vehicles are weighted in proportion to the 1988 vehicle model production and/or sales figures. The maximum octane number requirements of 1988 models with average sensitivity unleaded fuels were 84.7 (R+M)/2 octane numbers at the 50 percent satisfaction level, and 89.3 (R+M)/2 octane numbers at the 90 percent satisfaction level. Comparison with previous Surveys are made in this report. GRA

N90-16955# Army Armament Research and Development Command, Dover, NJ. Armament Engineering Directorate.
CRYSTAL STRUCTURE OF TETRA-AMMONIUM ADAMANTYL TETRA-NITRATE (TAATN): HIGH ENERGY/DENSITY FUEL CANDIDATE FOR LIQUID PROPELLANT
A. J. Bracuti Nov. 1989 20 p
(AD-A215684; ARAED-TR-89025) Avail: NTIS HC A03/MF A01 CSCL 19/1

The crystal structure of tetra-ammonium adamantyl tetra-nitrate was determined using 3-D single crystal x ray diffraction data. The tetragonal structure has unit cell dimensions a=b=10.046(1) and c=8.980(2). The x ray density is 1.643 grams per centimeter. GRA

N90-16956 ESDU International Ltd., London (England).
FATIGUE CRACK PROPAGATION RATES FOR TITANIUM ALLOY SHEET Abstract Only
Dec. 1989 30 p Supersedes ESDU-74006
(ESDU-89051; ISBN-0-85679-725-1; ISSN-0958-0387; ESDU-74006) Avail: ESDU

ESDU 89051 gives curves of constant amplitude crack propagation rate data for commercially pure titanium and five alloys (Ti-6Al-6V, Ti-4Al-3Mo-1V, Ti-5Al-2.5Sn, Ti-8Al-1Mo-1V and Ti-2.5 Cu). The data are derived from sources in the literature for tests in laboratory air at room temperature and are presented in terms of stress intensity factor range and stress ratio. As well as a mean curve, a curve is given representing the upper limit of 95 percent of the data. The effect of variation in stress ratio, frequency, sheet thickness, grain orientation, heat treatment and alloy composition is discussed. Details of all the alloys are tabulated together with the coefficients in the simple crack growth equation, and summary curves compare the performance of the different alloys. ESDU

29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.
For biological materials see *55 Space Biology.*

N90-16957# Creare, Inc., Hanover, NH.
DESIGN MANUAL FOR MICROGRAVITY TWO-PHASE FLOW AND HEAT TRANSFER Final Report, Sep. 1988 - Jun. 1989
Christopher J. Crowley and Michael G. Izenson Oct. 1989 143 p
(Contract F04611-88-C-0050)
(AD-A214937; TM-1309; AFAL-TR-89-027) Avail: NTIS HC A07/MF A01 CSCL 20/13

Two phase fluid flow and heat transfer methods for microgravity environments is documented. The applications of the work are thermal management, propulsion, and fluid storage and transfer systems for spacecraft. In the near future, these systems will include two phase, vapor-liquid flows. This Design Manual is intended for use by designers of these systems. Design methods are presented for predicting two phase flow regimes and pressure drops in pipe flows from earth gravity to microgravity conditions. Forced convection boiling heat transfer methods for pipes with uniform heat flux are included. Also included are methods for analyzing high vapor-shear condensation in pipes. The analysis methods are mechanistic; that is, based upon fundamental physical principles which should apply to heat transfer liquids with Pr approx = 1 and scale with pipe size and fluid properties. This Manual incorporates simplified methods (easy-to-use design charts), detailed descriptions of the analysis methods, comparisons with existing microgravity data, and recommended approaches to quantify the range of uncertainty in design calculations. GRA

N90-16958# European Space Agency, Paris (France).
COMBUSTION EXPERIMENTS DURING KC-135 PARABOLIC FLIGHTS
Brigitte Kaldeich, ed. Aug. 1989 71 p Original contains color illustrations
(ESA-SP-1113; ISBN-92-9092-008-4; ETN-90-96197) Copyright Avail: NTIS HC A04/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 30 Dutch guilders

The results of combustion experiments conducted during the parabolic flights of KC-135 aircraft in 1986 and 1987 are presented. The aim of the project is the investigation of combustion phenomena under microgravity conditions. The areas of interest are the following: solid surface combustion, flame spreading, liquid surface combustion (pool fires), droplet combustion and evaporation, particle cloud combustion, premixed gas flame propagation, gas jet diffusion flames, turbulent flow combustion control of flames by electric fields and fire safety aspects. The results obtained clearly demonstrate the value of parabolic flights for short-duration experiments. Even though residual accelerations and g-jitter are considerable, quantitative results are obtained and valuable experience is gained with these experiments. For individual titles, see N90-16959 through N90-16966.

N90-16959# Centre National de la Recherche Scientifique, Meudon-Bellevue (France). Lab. d'Aerothermique.
PREMIXED FLAMES IN MICROGRAVITY
D. Durox, R. PrudHomme, and P. Scouflaire *In* ESA, Combustion Experiments during KC-135 Parabolic Flight Aug. 1989 p 1-9 Original contains color illustrations (For primary document see N90-16958 09-29)
Copyright Avail: NTIS HC A04/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 30 Dutch guilders

Experiments with premixed air/methane bunsen-type flames are performed in microgravity conditions. The aim is to observe the effect of gravity on the flame shape, to see how the oscillation of the peak behaves during the period of microgravity, and to observe how rich enough flames behave when there is no buoyancy effect. The results showed that: the flame pumping at the top is due to buoyancy effect and disappears in microgravity; in the case of a stoichiometric combustion, a weak decrease of the flame area occurs between zero and two grams; as far as rich flames are concerned, a strong swelling of the flame area in observed, involving a strong reduction of the burning process. ESA

N90-16960# Ruhr Univ., Bochum (Germany, F.R.).
FLOW FIELD OBSERVATION OF A HOT He-CO2 JET IN MICROGRAVITY
A. Leipertz, H. Kremer, and K. Koencke *In* ESA, Combustion Experiments during KC-135 Parabolic Flight Aug. 1989 p 11-15 Original contains color illustrations (For primary document see N90-16958 09-29)
Copyright Avail: NTIS HC A04/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 30 Dutch guilders

Combustion experiments in the laminar/turbulent transition region of diffusion flames are performed. An experiment is performed to observe the expected flow field which is simulated by an appropriate gas jet. A gas mixture of helium and carbon dioxide is heated up to 180 C maximum and ejected through a nozzle. An infrared camera detected and visualized the gas flow. Compared with normal gravity conditions, differences in the upper part of the flow field are observed in microgravity. ESA

N90-16961# Imperial Coll. of Science and Technology, London (England).
MEASUREMENTS OF MEAN AND FLUCTUATING TEMPERATURE IN MICROGRAVITY
F. C. Lockwood and S. Godoy *In* ESA, Combustion Experiments during KC-135 Parabolic Flight Aug. 1989 p 17-19 Sponsored by ESA/ESTEC (For primary document see N90-16958 09-29)
Copyright Avail: NTIS HC A04/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 30 Dutch guilders

In the scope of the microgravity combustion program, measurements of mean and fluctuating temperatures, under microgravity conditions, are performed. The aim is to demonstrate that the measurements in a buoyancy flow can be conveniently made in microgravity, and to obtain initial data on these quantities. The possibility of data obtention is demonstrated. It is shown that

when the effect of buoyancy is removed, only fluctuations associated with the turbulence generated by energy of the high Reynolds number fluid are present. ESA

N90-16962# Imperial Coll. of Science and Technology, London (England).
ELECTRIC FIELD-INDUCED FLAME CONVECTION IN THE ABSENCE OF GRAVITY
F. B. Carleton and F. J. Weinberg *In* ESA, Combustion Experiments during KC-135 Parabolic Flight Aug. 1989 p 21-24 Sponsored in part by ESA Original contains color illustrations (For primary document see N90-16958 09-29)
Copyright Avail: NTIS HC A04/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 30 Dutch guilders

An alternative method of managing combustion processes based on the application of electric fields, in microgravity conditions is proposed. The process can be achieved using lightweight, compact equipment. Repeated microgravity experiments of a duration not exceeding 30 seconds and photographic recording of flow patterns are performed. The proposed system can be applied to provide intense heating of small areas, making economic use of available heating of small areas, making economic use of available oxygen, and using liquid or solid fuels requiring no pressure containment. ESA

N90-16963# Centre National de la Recherche Scientifique, Orleans (France). Centre de Recherches Sur la Chimie de la Combustion et des Hautes Temperatures.
DROPLET VAPORISATION AND COMBUSTION IN MICROGRAVITY
I. Goekalp, C. Chauveau, J. R. Richard, W. Leuckel, and M. Kramer (Karlsruhe Univ., Germany, F.R.) *In* ESA, Combustion Experiments during KC-135 Parabolic Flight Aug. 1989 p 25-36 Sponsored by ESA and CNES Original contains color illustrations (For primary document see N90-16958 09-29)
Copyright Avail: NTIS HC A04/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 30 Dutch guilders

A droplet burning facility, allowing investigations of droplet vaporization and combustion under different dynamic and thermal conditions, is constructed. The system is operated under microgravity conditions by means of parabolic flights. Data on droplet evaporation and burning under reduced gravity conditions is collected. The data concerns the vaporization of heptane droplets in stagnant environment and in the presence of forced convection. The results show that an improved set of experimental data can be obtained if some modifications are made on the suspending filament and on the ignition system. ESA

N90-16964# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
POLYMER GROUP MICROGRAVITY COMBUSTION EXPERIMENT
D. Bryant and M. Judd *In its* Combustion Experiments during KC-135 Parabolic Flight Aug. 1989 p 37-52 Original contains color illustrations (For primary document see N90-16958 09-29)
Copyright Avail: NTIS HC A04/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 30 Dutch guilders

An experiment on the burning characteristics of polymer materials under reduced gravity was performed. The materials chosen included Pyrell foam and G10 printed-circuit board, which is covered with Solithane 113 conformal coating. Parabolic flights in KC-135 aircraft are performed. Data is compared with ground experiment results from a combustion chamber. It is shown that: gravity plays an important role in the combustion of materials; the absence of gravity reduces the overall rate of propagation along a surface and reduces the flame temperature; and microgravity also reduces the air gap across which burning can propagate. ESA

N90-16965# Escuela Tecnica Superior de Ingenieros Aeronauticos, Madrid (Spain). Lab. de Propulsion.
HETEROGENEOUS COMBUSTION PROCESSES UNDER MICROGRAVITY CONDITIONS
C. SanchezTarifa, A. Linan, J. J. Salva, G. Corchero, G. L. Juste, and F. Esteban *In* ESA, Combustion Experiments during KC-135 Parabolic Flight Aug. 1989 p 53-64 Sponsored by ESA Original contains color illustrations (For primary document see N90-16958 09-29)
Copyright Avail: NTIS HC A04/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 30 Dutch guilders

In the scope of the program on flame spreading over the surface of plexiglass samples in reduced gravity, parabolic flight experiments are performed. The results of flight and ground experiments, under 1g, are compared. The investigation shows that: the flame spreads in microgravity; flame-spreading velocities are lower under microgravity; the influence of gravity decreases when the mixture pressure is reduced; when the oxygen concentration decreases the difference between 1g and under microgravity also decreases; and flame-spreading velocities are lower for bidimensional than for cylindrical symmetry. ESA

N90-16966*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A COMPARISON OF EUROPEAN AND AMERICAN MICROGRAVITY COMBUSTION EXPERIMENTAL TECHNIQUES
Kurt Sacksteder *In* ESA, Combustion Experiments during KC-135 Parabolic Flight Aug. 1989 p 65-69 Original contains color illustrations (For primary document see N90-16958 09-29)
Copyright Avail: NTIS HC A04/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 30 Dutch guilders

The European and the NASA microgravity combustion programs are complementary in many aspects. Differences appear in the technical approaches and cooperative efforts are beneficial. Droplet combustion gaseous fuel studies and the study of solid-fuel combustion are areas of common interest. It is recognized that the progress that can be made in low gravity combustion investigations, depends on advanced diagnostic tools, developed for normal gravity laboratories. The benefits of combustion experiments in reduced gravity, the ground-based low gravity facilities and the NASA microgravity combustion program are also considered. ESA

N90-16967# Pacific Northwest Lab., Richland, WA.
AN ENGINEERING APPROACH TO TWO-PHASE FLOW MODELING IN REDUCED GRAVITY
Judith M. Cuta Jan. 1990 7 p Presented at the 7th Symposium on Space Nuclear Power Systems, Albuquerque, NM, 7-10 Jan. 1990
(Contract DE-AC06-76RL-01830)
(DE90-005539; PNL-SA-17510; CONF-900109-17) Avail: NTIS HC A02/MF A01

This paper presents a general approach for developing specific two-phase flow parameters that could be used in the analysis of fluid behavior in reduced gravity. We begin from a theoretical basis, determine the appropriate modifications required for reduced gravity, define a relevant data base for derivation of empirical terms, and look at the data needed for proper validation of the model. DOE

N90-16794# International Maritime Satellite Organization, London (England).
FINANCIAL AND COMMERCIAL ISSUES: A CUSTOMER'S PERSPECTIVE
Ramin Khadem *In* ESA, Progress in Space Transportation Aug. 1989 p 95-97 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

N90-17102*# Alabama Univ., Birmingham. Dept. of Physiological Optics and Optometry.
PROTEIN CRYSTAL GROWTH IN MICROGRAVITY
William M. Rosenblum, Lawrence J. DeLucas, and William W. Wilson (Mississippi State Univ., Mississippi State.) *In* NASA,

Lewis Research Center, NASA Laser Light Scattering Advanced Technology Development Workshop, 1988 Aug. 1989 p 235-256 (For primary document see N90-17085 09-35) Avail: NTIS HC A14/MF A02 CSCL 22A

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N90-16968*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AN AUGER ELECTRON SPECTROSCOPY STUDY OF SURFACE-PREPARATION CONTAMINANTS
D. Wu (Old Dominion Univ., Norfolk, VA.), R. M. Stephens, R. A. Outlaw, and P. Hopson Washington Feb. 1990 16 p (NASA-TP-2972; L-16653; NAS 1.60:2972) Avail: NTIS HC A03/MF A01 CSCL 13B

There are many cleaning techniques that are presently being employed for surface preparation of materials that are subsequently exposed to ultrahigh vacuum (UHV). Unfortunately, there are virtually no comparative measurements which establish the residual contaminant level of each method. In this report, eleven different cleaning methods, ranging from only detergent cleaning to electrochemical polishing, were applied to identical samples of 347 stainless steel. Two surface conditions, a standard machined surface and a mechanically polished surface, were studied. Auger electron spectroscopy (AES) within a UHV environment was then used to detect the types of contaminants and the magnitudes found on the sample surfaces. It was found that the electrochemical polishing gave the least contaminated surface of all metals studied and that mechanically polished surfaces were significantly cleaner than the as-machined surfaces for any given cleaning method. Furthermore, it was also found that the residual contaminations left by methanol, ethanol, isopropyl alcohol, acetone, and freon finishing rinses are almost the same. Author

N90-16969# National Science Foundation, Washington, DC. Div. of Science Resources Studies, Surveys, and Analysis Section.
PROFILES-AERONAUTICAL/ASTRONAUTICAL ENGINEERING: HUMAN RESOURCES AND FUNDING Special Report, 1976 - 1986
Mary V. Burke Nov. 1988 157 p (PB90-103888; NSF-89-314) Avail: NTIS HC A08/MF A01 CSCL 13B

Attention is focused on the field of aeronautical/astronautical engineering. This report provides current and historical information on personnel, education, and funding for the field through the use of graphs and detailed statistical tables. GRA

N90-16970# Rock Island Arsenal, IL. Science and Engineering Directorate.
APPLICATION OF HIGH-RATE CUTTING TOOLS Final Report, 1982 - 1988
John L. Moriarty, Jr. 30 Mar. 1989 132 p (AD-A214644; SE-89-03) Avail: NTIS HC A07/MF A01 CSCL 13/9

Widespread application of the newest high-rate cutting tools to the most appropriate jobs is slowed by the sheer magnitude of developments in tool types, materials, workpiece applications, and by the rapid pace of change. Therefore, a study of finishing and roughing sizes of coated carbide inserts having a variety of geometries for single point turning was completed. The cutting tools were tested for tool life, chip quality, and workpiece surface finish at various cutting conditions with medium alloy steel. An empirical wear-life data base was established, and a computer program was developed to facilitate technology transfer, assist selection of carbide insert grades, and provide machine operating parameters. A follow-on test program was implemented suitable for next generation coated carbides, rotary cutting tools, cutting fluids, and ceramic tool materials. GRA

N90-16971# Center for Night Vision and Electro-Optics, Fort Belvoir, VA.
REDUCED VOLTAGE AND RESTART TESTING OF THE 1-WATT INTEGRAL CRYOGENIC COOLER (HD-1033B/C/D) Final Report, 4 Apr. - 12 May 1988
H. Dunmire and J. Shaffer Sep. 1989 94 p (AD-A215133; AMSEL-NV-TR-0085) Avail: NTIS HC A05/MF A01 CSCL 20/13

This final report describes and provides the data on the reduced voltage (108 VAC) and restart testing of the 1-Watt Integral Stirling Cooler. The 1-Watt Integral Cooler (HD-1033B/C/D) is currently used in the M1 FLIR, M60 FLIR, and the Advanced Attack Helicopter FLIR. The cooler specification requires that the cooler operate from 115 to 119 VAC. Because of the potential of lower voltage operation in some systems, C2NVEO evaluated the cooler performance and restartability at environmental extremes with 108 VAC. The coolers successfully passed all testing at all environmental conditions using both voltages. GRA

32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

N90-16972 Pennsylvania Univ., Philadelphia.
LONG TERM INTEGRATION FOR RADAR DETECTION OF SMALL TARGETS IN CLUTTER Ph.D. Thesis
Mark Robert Allen 1988 221 p
Avail: Univ. Microfilms Order No. DA8908299

The long term noncoherent integration to detect radar targets with very small cross sections is investigated. Because of the long integration times, the target travels over several resolvable volumes; hence the integration must cover multiple resolvable volumes. Long term integration can provide at least 10 dB detection sensitivity increase over conventional cumulative detection for a shipboard radar against sea skimming cruise missiles. Physically, this improvement comes from the ability of long term integration to smooth over spatial variations of sea clutter, as well as over target fluctuations. Since the actual target path differs from each of stored integration paths, collapsing loss from addition of interference results. The number and kinds of paths also affect false alarm rate. For our implementation of constant radial velocity paths within volumes illuminated by single beams, the method of path placement optimizing these geometric aspects is developed. Sea clutter at low grazing angles is modeled with correlated temporal fluctuations whose local mean is also random and varies across resolvable areas. We next develop the first detection analysis that handles this entire clutter model. Detection performance including CFAR loss, is presented parametrically for integration within a single resolvable sea clutter area.
Dissert. Abstr.

N90-16973 Boston Univ., MA.
MAKING EXTENSIBLE DATABASE TECHNOLOGY WORK Ph.D. Thesis
John Connor Sieg, Jr. 1989 309 p
Avail: Univ. Microfilms Order No. DA8917228

Extensible database systems support the creation of new data types and new access methods. Though the pioneers of extensible database technology have made remarkable strides in a short time, the technology is still entrenched in the methods of conventional database systems. Researchers propose four new strategies for building extensible database systems: (1) compiling queries into a storage-device independent, multiprocessing language called UNSOL, (2) permitting storage managers to fix many buffers at once, (3) using materialized views as access structures, and (4) modularizing the optimizer into independent

experts. Here, researchers detail each of these strategies, and describe the design of an extensible database system based on these strategies. Dissert. Abstr.

N90-16974*# National Aeronautics and Space Administration. Pasadena Office, CA.
ANALOG HARDWARE FOR DELTA-BACKPROPAGATION NEURAL NETWORKS Patent Application
Silvio P. Eberhardt, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 29 Sep. 1989 17 p
(Contract NAS7-918)
(NASA-Case-NPO-17564-1-CU; NAS 1.71:NPO-17564-1-CU; US-Patent-Appl-SN-414811) Avail: NTIS HC A03/MF A01 CSCL 20N

This is a fully parallel analog back propagation learning processor which comprises a plurality of programmable resistive memory elements serving as synapse connections whose values can be weighted during learning with buffer amplifiers, summing circuits, and sample-and-hold circuits arranged in a plurality of neuron layers in accordance with delta- back propagation algorithms modified so as to control weight changes due to circuit drift. NASA

N90-16975*# National Aeronautics and Space Administration. Pasadena Office, CA.
PHASE AMBIGUITY RESOLUTION FOR OFFSET QPSK MODULATION SYSTEMS Patent Application
Tien M. Nguyen, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 30 Nov. 1989 35 p
(Contract NAS7-918)
(NASA-Case-NPO-17853-1-CU; US-Patent-Appl-SN-443539; NAS 1.71:NPO-17853-1-CU) Avail: NTIS HC A03/MF A01 CSCL 17B

A demodulator for Offset Quaternary Phase Shift Keyed (OQPSK) signals modulated with two words resolves eight possible combinations of phase ambiguity which may produce data error by first processing received I(sub R) and Q(sub R) data in an integrated carrier loop/symbol synchronizer using a digital Costas loop with matched filters for correcting four of eight possible phase lock errors, and then the remaining four using a phase ambiguity resolver which detects the words to not only reverse the received I(sub R) and Q(sub R) data channels, but to also invert (complement) the I(sub R) and/or Q(sub R) data, or to at least complement the I(sub R) and Q(sub R) data for systems using nontransparent codes that do not have rotation direction ambiguity. NASA

N90-16976# General Electric Co., Daytona Beach, FL. Simulation and Control Systems Dept.
SIMULATION OF SYNTHETIC APERTURE RADAR 2: SIMULATING SAR (SYNTHETIC APERTURE RADAR) USING THE ADVANCED VISUAL TECHNOLOGY SYSTEM Interim Report, Jan. 1987 - Mar. 1989
Robert L. Ferguson, John Ellis, Steven R. French, Jeanne Ball, Lisa Spencer, Herbert H. Bell, and Peter M. Crane (Air Force Human Resources Lab., Williams AFB, AZ.) Oct. 1989 18 p
(Contract F33615-84-C-0063)
(AD-A213659; AFHRL-TR-89-16) Avail: NTIS HC A03/MF A01 CSCL 17/9

The Advanced Visual Technology System (AVTS) computer image generator was modified to produce highly accurate simulations of synthetic aperture radar (SAR) reflectively and elevation effects that can be precisely correlated with corresponding visual and infrared imagery. The resulting SAR snapshot is a plan view of the selected patch area with the field-of-view corresponding to a selected scale of 0.65, 1.3, or 2.6 nm. The image generator is interrupted for only one frame time, during which the entire processing power of the AVTS, up to 4,000 polygons, is brought to bear on the SAR snapshot. Once the SAR patch is computed, the AVTS continues with visual and infrared processing. A post-processor then adds feature and terrain shadows, horizontal and vertical incidence effects, resolution fall-off in azimuth and range, and speckle. GRA

N90-16977# Swedish Defence Research Establishment, Linkoeping. Dept. of Information Technology.
FINITE ELEMENT ANALYSIS OF PROPAGATION IN WAVEGUIDE COMPONENTS WITH APPLICATION TO FERRITE PHASE SHIFTERS
Jan Svedin May 1989 51 p
(FOA-C-30529-3.2; ISSN-0347-3708; PB90-110354; ETN-90-95920) Avail: NTIS HC A04/MF A01; Swedish Defence Research Establishment, Box 1165, S-581 11 Linkoeping, Sweden, 50 Swedish crowns

The propagation analysis of ferrite components, such as variable phase shifters, is discussed. A computer program for calculation of the magnetostatic fields is presented. An iterative self-consistent solution of the rigorous nonlinear magnetostatic integral equation is sought, using an expansion of the magnetization on zero order rectangular finite elements, and a constitutive relation expressed in terms of one-dimensional magnetization loops. The magnetostatic fields obtained are used to calculate the inhomogeneous permeability tensor, after which a finite-element method, in terms of the transversal field components, is utilized to calculate propagation characteristics for possible electrodynamic eigenmodes. By the use of a Galerkin procedure, the applicability of the finite-element formulation is extended to include structures with losses. ESA

N90-16978# Naval Research Lab., Washington, DC. Communication Systems Engineering Branch.
PERFORMANCE OF CELLULAR FREQUENCY-HOPPED SPREAD-SPECTRUM RADIO NETWORKS Memorandum Report
Jeffrey W. Gluck and Evaggelos Geraniotis (Maryland Univ., College Park.) 18 Oct. 1989 44 p
(Contract N00014-85-G-0207)
(AD-A214480; NRL-MR-6567) Avail: NTIS HC A03/MF A01 CSCL 25/2

Multiple access interference is characterized for cellular mobile networks, in which users are assumed to be Poisson-distributed in the plane and employ frequency-hopped spread-spectrum signaling with transmitter-oriented assignment of frequency-hopping patterns. Exact expressions for the bit error probabilities are derived for binary coherently demodulated systems without coding. Approximations for the packet error probability are derived for coherent and noncoherent systems and these approximations are applied when forward-error-control coding is employed. In all cases, the effects of varying interference power are accurately taken into account according to some propagation law. Numerical results are given in terms of bit error probability for the exact case and throughput for the approximate analyses. Comparisons are made with previously derived bounds and it is shown that these tend to be very pessimistic. GRA

N90-16979# Surveillance Research Lab., Salisbury (Australia).
A TECHNIQUE FOR THE GENERATION OF RANGE-HEIGHT-ANGLE CHARTS
J. L. Whitrow and J. A. Doig May 1989 31 p
(AD-A214534; SRL-0027-TM; DODA-AR-005-898) Avail: NTIS HC A03/MF A01 CSCL 20/14

This memorandum discusses a technique for the computer generation of range-height-angle coverage charts for radars of arbitrary height. Such charts are useful to provide a qualitative assessment of propagation paths between a radar and an arbitrarily positioned target. GRA

N90-16980# Aerospace Corp., El Segundo, CA. Electronics Research Lab.
COMPRESSION PHENOMENA IN HARD-SATURATED MICROWAVE AMPLIFIERS
Stephen A. Maas 30 Sep. 1989 22 p
(Contract F04701-88-C-0089)
(AD-A214546; TR-0089(4925-02)-1; SD-TR-89-79) Avail: NTIS HC A02/MF A01 CSCL 09/1

An earlier report described the anomalous compression of a weak signal by a stronger one in a hard-saturated FET amplifier.

It was shown that the amplifier's compression characteristics were not consistent with the conventional theory of hard limiters. The hard-limiter theory is recast in terms of a Volterra series, and shows that the previously unexplained compression characteristics are to be expected in hard-saturated multistage amplifiers. GRA

N90-16981# Rockwell International Corp., Richardson, TX. Digital Systems Group.
PACKET RADIO INTEGRATED SYSTEM MODULE (PRISM): DESIGN DOCUMENT Report, May 1984 - Aug. 1989
Neil Gower Aug. 1989 47 p
(Contract N00140-87-C-8903; ARPA Order 6067)
(AD-A214723) Avail: NTIS HC A03/MF A01 CSCL 25/2

The design of the Packet Radio Integrated System Module (PRISM) is described along with the purpose and motivations for designing the PRISM, the unique concepts developed for the PRISM, applicability of the PRISM concepts to other networks and significant decisions during development of the PRISM. The PRISM provides physical and electrical requirements to house and interconnect eight Low-cost Packet Radios (LPRs) and eight Network Interface Units (NIUs). PRISMs can be concatenated to create a large network of over 100 radios. The PRISM contains an RF switching subsystem, which allows the experimenter to configure the LPRs into various connectivities of strings, areas of full connectivity, grids of radios in a continuum of connectivity and mobile connectivity as well as console switching to allow the experimenter to access any single console port of the NIUs and LPRs in the PRISM system. GRA

N90-16982# Naval Research Lab., Washington, DC. Human-Computer Interaction Lab.
VOICE PREPROCESSOR FOR DIGITAL VOICE APPLICATIONS Interim Report
G. S. Kang, L. J. Fransen, and T. M. Moran 11 Sep. 1989 41 p
(AD-A214726; NRL-9206) Avail: NTIS HC A03/MF A01 CSCL 25/3

A voice processor operating satisfactorily in laboratory environments with carefully prerecorded speech samples often fails to operate satisfactorily with live speech. Potential reasons are: (1) the speech level may be too high or too low; (2) the speech signal may have too much interference (ambient noise, breath noise, 60 Hz hum, digital noise in analog circuits, a DC bias (caused by component aging, etc.) generated at the analog-to-digital converter output); (3) the microphone frequency may be severely distorted; (4) the speech signal from the existing audio system, in certain operating environments, may be improperly coupled to the front-end circuit; (5) the speaker may be talking too fast or may have an improper mouth-to-microphone distance, or the speech may lack high-frequency energies. In this report, we have generated a comprehensive design for a speech preprocessor that removes interferences, adaptively equalizes frequency anomalies, and conditions speech for speech encoding, speech recognition, speaker recognition, or extraction of verbal or nonverbal information from speech. GRA

N90-16983# Massachusetts Inst. of Tech., Cambridge.
OBLIQUE IONOSPHERIC HEATING AND EFFECTS ON RADIO PROPAGATION Final Technical Report, 14 May - 30 Sep. 1987
Min-Chang Lee Jun. 1989 42 p
(Contract F30602-81-C-0206; AF Proj. 4600)
(AD-A214756; RADC-TR-89-71) Avail: NTIS HC A03/MF A01 CSCL 20/14

The process of self focusing of high intensity Gaussian HF electromagnetic beams in the ionosphere is studied. Analytic expressions for threshold intensity, growth rate and focal length are obtained in terms of the beam parameters for self focusing due to the ponderomotive force. Spectral broadening of VLF waves traversing the ionosphere has been studied. Two mechanisms, nonlinear scattering and parametric excitation of lower hybrid waves, are shown to provide nonlinear mode conversion of VLF waves into electrostatic plasma modes in the presence of ionospheric density striations. The proposed mechanisms can be tested in an experiment that combines the operation of HF and VLF ionospheric heaters. GRA

N90-16984# North Carolina Univ., Chapel Hill. Dept. of Statistics.
INFORMATION CAPACITY OF THE MATCHED GAUSSIAN CHANNEL WITH JAMMING. 1: FINITE-DIMENSIONAL CHANNEL
Charles R. Baker and I. F. Chao (Soochow Univ., Taipei, Taiwan) Apr. 1989 38 p
(Contract N00014-86-K-0039; NSF NCR-87-13726)
(AD-A214782; LISS-34) Avail: NTIS HC A03/MF A01 CSCL 12/9

Information capacity is considered for the finite-dimensional additive Gaussian channel subject to jamming. The problem is modeled as a zero-sum two-person game with mutual information as payoff function. The jammer does not control the ambient Gaussian noise, which is not assumed negligible. The unique saddle point and saddle value are determined, along the jammer's minimax strategy. GRA

N90-16985# Houston Univ., TX. Applied Electromagnetics Lab.
A STUDY OF LOADED MICROSTRIP ANTENNAS AND THEIR APPLICATIONS TO ARRAYS Final Technical Report, Jun. - Dec. 1986
William F. Richards, Ajaz A. Khan, and Stuart A. Long Mar. 1989 94 p
(Contract F30602-81-C-0202)
(AD-A214857; TR-87-13; RADC-TR-89-10) Avail: NTIS HC A05/MF A01 CSCL 20/14

An experimental study of reactively loaded rectangular microstrip antennas is presented. The reactive loads used here were either a single pin, or a symmetrically located pair of pins, short circuiting points on the patch to corresponding points on the ground plane. A set of points forming a single curve for the case of one shorting pin or two symmetrically located curves for the case of two shorting pins was found. A single, or a pair of short circuits placed at any point on these curves results in an element having a fixed resonant frequency and a fixed radiation pattern independent of the point selected. The input impedance, however, varies over a very large range when a short circuit or pair of short circuits is moved along these curves. The major application is the study of the feasibility of maintaining an impedance match for the elements of a microstrip antenna array with changing scan angle by moving the position of one or two short-circuiting pins. An experimental and theoretical study of the mutual impedance for microstrip array elements was conducted and used in a computer program simulating a finite array. Though the model used for mutual impedance was some what crude, the simulation program predicted a variation of active element impedance with scan angle. For a number of different scan angles, the position of shorting pins was adjusted to obtain a match for all of the array elements thus indicating that this dynamic matching technique maybe feasible for scanner arrays. GRA

N90-16986# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
KNOWLEDGE BASED SIGNAL PROCESSING Final Report, 1 Jul. 1981 - 30 Sep. 1989
Alan V. Oppenheim 17 Nov. 1989 18 p
(Contract N00014-81-K-0742)
(AD-A214864) Avail: NTIS HC A03/MF A01 CSCL 09/1

A brief summary of the work in each of the seven topic areas is given. A complete listing is given of all of the publications based on work supported in whole or in part under this contract. One publication was selected as an example of each of the major topic areas, although it is not necessarily representative of the broad scope of the work under this topic. This set of papers is contained in the Appendix. Each of the publications selected has had, or is expected to have, a significant impact in the research community. A complete list is given of technical reports based on

work supported in whole or in part under this contract. A summary of honors and awards received during the life the contract is given. GRA

N90-16987# Alaska Univ., Fairbanks. Geophysical Inst.
FIRST RESULTS FROM HF (HIGH-FREQUENCY) OBLIQUE BACKSCATTER SOUNDINGS TO THE NORTHWEST OF COLLEGE, ALASKA USING A MODIFIED ULCAR DIGISONDE D-256 Final Report, Jul. 1987 - Oct. 1988
Robert D. Hunsucker and Brett S. Delana Mar. 1989 64 p
(Contract F19628-87-K-0048)
(AD-A214931; GL-TR-89-0135) Avail: NTIS HC A04/MF A01 CSCL 20/14

The modified air Weather Service Digital Ionospheric Sounding System (DISS, AN/FMQ12) is described in detail. The HF sounding system at College, Alaska is used to investigate the behavior of ground scatter, plus E and F-region direct backscatter caused by high latitude ionospheric irregularities. These echoes may manifest themselves as clutter in the proposed Alaskan OTH radar system. Soundings to the northwest of College were identified as ground scatter plus several types of auroral clutter echoes. GRA

N90-16988# Naval Research Lab., Washington, DC.
RESULTS ON THE DETECTION OF SIGNALS IN SPHERICALLY INVARIANT RANDOM NOISE Interim Report
Kevin J. Sangston and Karl Gerlach 17 Nov. 1989 15 p
(AD-A214933; NRL-9202) Avail: NTIS HC A03/MF A01 CSCL 17/9

A relationship between well-known estimator-correlator results from detection theory and the detection of signals in spherically invariant random noise is described. This relationship gives a general result concerning the structure of the likelihood ratio for this detection problem. Furthermore, an alternate formulation of both the likelihood ratio and the optimal estimator that arises in the estimator-correlator structure is given. This alternate formulation is important because it yields a closed-form solution for this optimal estimator without requiring explicit knowledge of a prior distribution for the unknown quantity being estimated. Since interest in modeling actual noise processes as spherically invariant random processes has recently appeared, the results here should help not only to give insight into the optimal detection structure in such noise but also to give guidance in formulating suboptimal detectors for problems of practical interest. GRA

N90-16989# Lowell Univ., MA. Center for Atmospheric Research.
USAF/GL METEOR SCATTER DATA ANALYSIS PROGRAM: A USER'S GUIDE
Jay A. Weitzen Jun. 1989 92 p
(Contract F19628-88-K-0004; AF Proj. 4643)
(AD-A214988; ULRF-448/CAR; GL-TR-89-0154; SR-2) Avail: NTIS HC A05/MF A01 CSCL 20/14

This document describes the use and theory of the Geophysics Laboratory meteor scatter data analysis package. Each of the 16 primary data analysis statistics is discussed along with options for each statistic and data output formats. Examples of analysis using each statistic are provided. Theory behind each statistic is described. GRA

N90-16990# Naval Ocean Systems Center, San Diego, CA.
SPECIFICATION FOR HF MAXIMUM USABLE FREQUENCY (MUF) MODEL Technical Document, Mar. - Sep. 1989
T. N. Roy Sep. 1989 40 p Sponsored by Naval Oceanographic Office, Bay Saint Louis, MS
(AD-A214996; NOSC/TD-1641) Avail: NTIS HC A03/MF A01 CSCL 20/14

This report documents a high-frequency (HF) maximum usable frequency (MUF) model called MINIMUF-85. Developed at the Naval Ocean Systems Center, this semiempirical model permits simplified HF propagation MUF predictions to be performed in near-real-time. The model predicts the MUF for arbitrary input values of receiver/transmitter position, date, time (UT), and solar sunspot number. Several algorithms are contained in the model to describe the dependence of the MUF on solar activity, geomagnetic latitude, time of year, and time of day. An appendix contains the computer FORTRAN 77 code required to implement the fundamental features of this model. GRA

N90-16991*# Stanford Univ., CA. Space, Telecommunications and Radio Science Lab.
RADIO NOISE MEASUREMENTS IN THE LONG-WAVE BAND AT THULE, GREENLAND Final Technical Report, Aug. 1984 - Jul. 1988
A. C. Fraser-Smith, P. R. McGill, Robert A. Helliwell, and Sibylle Houery Aug. 1989 71 p Sponsored in part by DNA
(Contracts NAGw-235; F19628-84-K-0043; N00014-81-K-0382)
(NASA-CR-182824; NAS 1.26:182824; AD-A215027; RADC-TR-89-94) Avail: NTIS HC A04/MF A01 CSCL 20/14

In August 1985, a Stanford University ELF/VLF radiometer was installed at Thule, Greenland to make measurements of the natural ELF/VLF (frequencies in the range 10 Hz to 32 kHz) radio noise background. Thule is very nearly unique in that it lies not only at a relatively high geographic latitude (76.55 deg) but it is also very close to the north geomagnetic pole, with the result that its radio noise background not only contains the normal lightning-generated noise typical of the lower latitudes (sferics, tweeks) but in addition it contains an unusual selection of magnetospherically-generated components (primarily ELF/VLF chorus and hiss) that cannot be observed on the ground, or are only rarely observed on the ground, at low and middle latitudes. The only other comparable location for such noise measurements is the Soviet station Vostok in the Antarctic. Many of the ELF and VLF radio noise measurements made at Thule in the three years the radiometer was started in operation was summarized and the noise statistics was compared with those from Sondrestromfjord, which is also located in Greenland, but at a lower latitude (66.99 deg N). GRA

N90-16992# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
CLASSIFICATION OF ACOUSTO-OPTIC CORRELATION SIGNATURES OF SPREAD SPECTRUM SIGNALS USING ARTIFICIAL NEURAL NETWORKS M.S. Thesis
John W. DeBerry May 1989 123 p
(AD-A215045; AFIT/GE/ENG/89D-10) Avail: NTIS HC A06/MF A01 CSCL 12/9

The primary goal of this research was to determine if artificial Neural Networks (ANNs) can be trained to classify the correlation signatures of direct sequence and frequency-hopped spread-spectrum signals. Secondary goals were to determine: (1) if network classification performance can be modeled with a conditional probability matrix, (2) if the symmetry of the matrices can be controlled, and (3) if using a majority vote rule over independently trained networks improves classification performance. Correlation signatures of the spread-spectrum signals were obtained from United States Army Harry Diamond Laboratories. The signatures were preprocessed and separated into various training and testing data sets. Thirty samples of network responses for several sets of training conditions were gathered using a neural network simulator. GRA

N90-16993# North Carolina Univ., Chapel Hill. Dept. of Statistics.
CODING CAPACITY FOR A CLASS OF ADDITIVE CHANNELS
Charles R. Baker May 1989 37 p
(Contracts N00014-86-K-0039; N00014-89-J-1175; NSF NCR-87-13726)
(AD-A215054; LISS-36) Avail: NTIS HC A03/MF A01 CSCL 12/9

Coding capacity is determined for a class of additive Gaussian channels, and bounds on capacity are obtained for a class of nonGaussian channels. The channels may be with or without memory, stationary or nonstationary. The constraint is partially given in terms of an increasing family of finite-dimensional subspaces. A general expression for the capacity is obtained, which depends upon the relation between the noise covariance and the constraint

on the generalized signal-to-noise energy ratio for the code words. The well-known expression for capacity of the discrete-time stationary Gaussian channel is shown to be a special case. The general expression provides new results on capacity for nonstationary discrete-time channels and for continuous-time channels (stationary or nonstationary) with fixed time of transmission. GRA

N90-16994# Clarkson Univ., Potsdam, NY.
NONLINEAR MODULATIONAL STABILITY AND PROPAGATION OF AN ELECTROMAGNETIC PULSE IN A TWO-COMPONENT, NEUTRAL PLASMA
Ronald E. Kates (Max-Planck-Inst. fuer Astrophysik, Garching, Germany, F.R.) and D. J. Kaup 10 Nov. 1989 30 p
(Contract N00014-88-K-0153; NSF DMS-85-01325)
(AD-A215131) Avail: NTIS HC A03/MF A01 CSCL 20/9

Nonlinear effects are studied including possible modulational instability of an intense electromagnetic pulse propagating through a fully-ionized, unmagnetized plasma. The envelope is shown to evolve over long time scales in general according to a vector form of the well-known cubic nonlinear Schroedinger (NLS) equation. Three distinct nonlinear effects contribute terms cubic in the amplitude and thus can be of comparable magnitude: ponderomotive forces, relativistic corrections, and harmonic generation. Influence of an ambient magnetic field on the nonlinear modulational stability of circularly polarized electromagnetic pulses in a two-component, neutral plasma; the nonlinear modulational stability properties of plasma electromagnetic pulses are extended to include the presence of an ambient magnetic field parallel to the direction of propagation. The positive component may consist of either positrons or singularly charged ions, and on specific assumptions or approximations are made concerning the mass ratio of the components. Approximate solutions are derived which describe the evolution of a circularly polarized pulse. The envelope is shown to evolve over long time scales according to the cubic nonlinear Schroedinger (NLS) equation. GRA

N90-16995# Naval Research Lab., Washington, DC. Space Sensing Branch.
MULTIBEAM RADAR ALTIMETRY: SPACEBORNE FEASIBILITY AND AIRBORNE EXPERIMENTATION Final Report, Oct. 1988 - May 1989
G. S. Brown, L. S. Miller, and L. W. Choy 19 Oct. 1989 35 p
Sponsored by Space and Naval Warfare System, Washington, DC
(AD-A215152; NRL-9229) Avail: NTIS HC A03/MF A01 CSCL 17/9

The results are summarized of an investigation into the technical feasibility of multibeam altimetry. Three candidate sensor concepts are considered: a real aperture system with an appropriate 4.5-m antenna for operation at 13.5 GHz or a 1.8-m antenna for operation at 36 GHz; a 13.5 GHz interferometer system; and a 13.5 GHz synthetic aperture system. The overall findings show a preference for the real aperture system, with a trade-off between the larger antenna required at 13.5 GHz and rain attenuation effects at 36 GHz. Both systems are shown to be capable of providing equal to or less than 5 cm height resolution and an approx. 19 km along-track spatial-wavelength resolution for the beam that is pointed 50 km off-nadir in the cross-track direction. An experimental aircraft program is also discussed. The objective is to provide experimental verification of these theoretical findings. GRA

N90-16996# North Carolina Univ., Chapel Hill. Dept. of Statistics.
INFORMATION CAPACITY OF DIMENSION-LIMITED CHANNELS
Charles R. Baker May 1989 22 p
(Contract N00014-89-J-1175; NSF NCR-87-13726)
(AD-A215238; LISS-37) Avail: NTIS HC A03/MF A01 CSCL 12/3

Average information capacity is determined for a class of communication channels containing additive noise. Gaussian noise processes and a large class of nonGaussian processes are included. The constraint on the transmitted signals is given in terms of an increasing family of finite-dimensional subspaces. The results apply to the classical discrete-time channel and to continuous-time channels with fixed signal duration. GRA

N90-16997# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
VERY BROAD BAND VHF/UHF OMNIDIRECTIONAL ANTENNA DESIGN STUDY M.S. Thesis
Gregory S. Clute Dec. 1989 150 p
(AD-A215358; AD-F000150; AFIT/GE/ENG/89D-6) Avail: NTIS HC A07/MF A01 CSCL 09/1

A number of broad band VHF/UHF antennas are examined with respect to their suitability for a small pilotless air vehicle (A/V). Specifically, the objective was to find a vertically polarized omnidirectional VHF/UHF antenna having a bandwidth of at least 4:1, and whose dimensions are compatible with the size limitations of a small A/V. An extensive literature review is included along with a computer analysis of a modified log-periodic dipole array, and an analysis of a number of thin wire open-sleeve dipole antennas. The objective of the open-sleeve dipole analysis was to determine how the impedance bandwidth can be broadened by adjusting sleeve length, sleeve spacing, and transmission line impedance. Results indicate that the thin wire open-sleeve antenna can, theoretically, attain a 3.6:1 bandwidth for a VSWR of 3.0:1 or a 1.6:1 bandwidth for a 2.0:1 VSWR. GRA

N90-16998# North Carolina Univ., Chapel Hill. Dept. of Statistics.
INFORMATION CAPACITY OF THE STATIONARY GAUSSIAN CHANNEL
Charles R. Baker and S. Ihara (Nagoya Univ., Japan) Jul. 1989 35 p
(Contract N00014-89-J-1175; NSF NCR-87-13727)
(AD-A215408; LISS-39) Avail: NTIS HC A03/MF A01 CSCL 12/9

The information capacity of the mismatched stationary continuous-time Gaussian channel is determined. The assumptions placed on the signal process are less restrictive than those given in previous treatments. Moreover, the assumptions used may have operational advantages over those used previously. GRA

N90-16999# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
PLANAR ARRAY ANTENNA DESIGN ANALYSIS, VOLUME 1 M.S. Thesis
Bradley P. Chrisman Dec. 1989 177 p
(AD-A215537; AFIT/GE/ENG/89D-4-Vol-1) Avail: NTIS HC A09/MF A02 CSCL 09/1

The purpose was to develop a computer program that can assess the impact of small design perturbations on the performance of a planar array antenna. The antenna designer can compare theoretical design calculations for an array with those of the perturbed array. Considerable work was spent validating each routine to ensure theoretical and expected results agreed with known examples found in the literature. The program calculates radiation pattern data, half-power beamwidths, and directivities for specified scan angles and frequency bandwidth for both the design array and expected array. The radiation pattern data can be plotted to allow a side lobe comparison between the design and expected arrays. GRA

N90-17000# Analytical Sciences Corp., Reading, MA.
NEW APPROACH TO OMEGA PPCS (PROPAGATION CORRECTIONS) Final Report
Peter B. Morris and Radha R. Gupta Nov. 1989 99 p
(Contract DTCG23-86-C-20024)
(AD-A215610; TIM-5351-9-1; USCG/ONSCEN-03-89) Avail: NTIS HC A05/MF A01 CSCL 20/14

The currently available propagation correction (PPC) model algorithm maintained by the U.S. Coast Guard Omega Navigation System Center was developed in 1980. Although an improvement over the earlier 1974 algorithm, the 1980 PCC model exhibits a number of deficiencies. To correct these deficiencies, a new

approach to modeling PPCs is presented. This model incorporates semi-empirical forms directly into the time-dependent portions of the model, thus insuring that the PPC predictions are directly data-driven and data collected during path transition conditions may be used for model calibration. A geomagnetic conductivity sub-model is described which provides effective phase velocity and excitation factor phase functional forms for day or night path segments with given geomagnetic bearing, geomagnetic latitude, and ground conductivity. This sub-model describes all space-dependent quantities (on which phase depends) except for the spatially anomalous ionospheres of the auroral and polar regions. A diurnal sub-model is described in which the diurnal phase behavior on a propagation path is treated as a sum of discrete phase changes on path segments having ionospheric reflection heights determined from classical Chapman photo-ionization models. In addition, onset and recovery times for sunrise and sunset are characterized by several parameters which can be adjusted to fit observed data. GRA

N90-17001# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
DEVELOPMENT OF A PARALLEL LINK MODEL FOR METEOR BURST COMMUNICATION M.S. Thesis
Ryan C. Cochran Dec. 1989 65 p
(AD-A215629; AFIT/GE/ENG/89D-7) Avail: NTIS HC A04/MF A01 CSCL 25/2

Meteor burst communication (MBC) constitutes an unusual propagation medium with many unique and interesting properties. These properties make MBC well suited for military applications. MBC offers many advantages over other forms of existing long range communication systems. Some of the advantages include low probability of intercept (LPI), antijam (AJ), flexibility and survivability. The LPI/AJ characteristics of MBC are the most important to military applications. MBC also suffers from two major drawbacks: long message delay times and low throughput. As a result, MBC systems exhibit low average data rates and long delay times. In order for MBC to gain widespread use, methods to optimizing system performance must be developed. The result is the development of a parallel MBC link model that is used to analyze MBC network performance. To address this issue, a computer model was developed to emulate a PAVE PAWS parallel link MBC network. This unique model was developed using the queueing model for a MBC channel. The queue used is a M/G/1 queue with server vacations. The model was implemented using two simulation programs which are supported on the IBM PC. The results of the simulation are validated by comparison to analytical data. The results gathered indicate that some performance gains are attainable if a MBC network is modeled using a parallel link model. It is shown that moderate increases in throughput and a reduction in message waiting tiem is possible. GRA

N90-17002# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
TARGET CLASSIFICATION USING SAR (SYNTHETIC APERTURE RADAR) POLARIMETRIC DATA M.S. Thesis
Alan P. Callaghan 1989 175 p
(AD-A215672; AFIT/GE/ENG/89D-58) Avail: NTIS HC A08/MF A01 CSCL 17/9

The polarimetric behavior of canonicals within single resolution cells is investigated. The aim of this investigation is to ascertain whether the contents of a resolution cell can be determined by examination of the polarimetric data. The canonicals addressed are the dihedral and the flatplate, although the associated theory and software is readily applicable to other primitives. The main software package used is SARTOOL, although additional ancillary software is presented such that the output of SARTOOL can be represented on the Poincare sphere. Finally, both single level and multi-level perceptron networks are used to process the resolution cell output and return a decision on the contents of the cell. This preliminary study of the polarimetric and perceptron combination provides some valuable insight into the possible potential of polarimetrics and Artificial Intelligence in the area of target identification. GRA

N90-17003# Naval Postgraduate School, Monterey, CA.
ERROR DETECTION AND CORRECTION FOR A MULTIPLE FREQUENCY QUATERNARY PHASE SHIFT KEYED SIGNAL M.S. Thesis
Kevin S. Hopkins Jun. 1989 60 p
(AD-A215706) Avail: NTIS HC A04/MF A01 CSCL 12/5

A multiple frequency quaternary phased shift (MFQPSK) signaling system was developed and experimentally tested in a controlled environment. In order to insure that the quality of the received signal is such that information recovery is possible, error detection/correction (EDC) must be used. Various EDC coding schemes available are reviewed and their application to the MFQPSK signal system is analyzed. Hamming, Golay, Bose-Chaudhuri-Hocquenghem (BCH), Reed-Solomon (R-S) block codes as well as convolutional codes are presented and analyzed in the context of specific MFQPSK system parameters. A computer program was developed in order to compute bit error probabilities as a function of signal to noise ratio. Results demonstrate that various EDC schemes are suitable for the MFQPSK signal structure, and that significant performance improvements are possible with the use of certain error correction codes. GRA

N90-17004# Lawrence Livermore National Lab., CA.
TWO-DIMENSIONAL, LONG-PULSE SIMULATION OF MICROWAVE-INDUCED ELECTRON LAYER EVOLUTION IN LOW-PRESSURE AIR
D. J. Mayhall, J. H. Yee, G. E. Sieger, and R. A. Alvarez Nov. 1989 10 p Presented at the High Powered Microwave and Broadband Radio Frequency Propagation/Phenomenology/ Methodology Workshop, Livermore, CA, 23-26 Oct. 1989 Submitted for publication
(Contract W-7405-eng-48)
(DE90-005180; UCRL-101750; CONF-891097-3) Avail: NTIS HC A02/MF A01

Laboratory chamber experiments in low-pressure (0.1 to 10 Torr) air with long-pulse (150 to 600 ns), 2.856 GHz crossed microwave beams, created by the reflection of an incident beam from a metal plate inclined at 45 degrees, have shown that multiple, luminous electron density layers form toward the source of the incident beam. Previous two-dimensional calculations of microwave air breakdown with full resolution of each radio frequency cycle required Cray 1 computation times of about 0.5 hr/ns of simulation time. To simulate experiments with pulses of 150 to 600 ns duration, computation times with full cycle resolution must be expected to be 75 to 300 hours per run. Because of these prohibitive amounts of computer time, a code, which follows only the driving pulse envelope, has been developed. This is an extension of the previous one-dimensional technique for atmospheric microwave propagation. DOE

N90-17005* National Aeronautics and Space Administration. Pasadena Office, CA.
APPARATUS FOR USING A TIME INTERVAL COUNTER TO MEASURE FREQUENCY STABILITY Patent
Charles A. Greenhall, inventor (to NASA) 27 Jun. 1989 96 p
(NASA-Case-NPO-17325-1-CU; US-Patent-4,843,328; US-Patent-Appl-SN-184235; US-Patent-Class-324-78Z; US-Patent-Class-324-78D) Avail: U.S. Patent and Trademark Office CSCL 20N

An apparatus for measuring the relative stability of two signals is disclosed comprising a means for mixing the two signals down to a beat note sine wave and for producing a beat note square wave whose upcrossings are the same as the sine wave. A source of reference frequency is supplied to a clock divider and interval counter to synchronize them and to generate a picket fence for providing a time reference grid of period shorter than the beat period. An interval counter is employed to make a preliminary measurement between successive upcrossings of the beat note square wave for providing an approximate time interval therebetween as a reference. The beat note square wave and

the picket fence are then provided to the interval counter to provide an output consisting of the time difference between the upcrossing of each beat note square wave cycle and the next picket fence pulse such that the counter is ready for each upcrossing and dead time is avoided. A computer containing an algorithm for calculating the exact times of the beat note upcrossings then computes the upcrossing times.

Official Gazette of the U.S. Patent and Trademark Office

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics*.

N90-17006# Bureau of Mines, Pittsburgh, PA. Research Center.

INTRINSICALLY SAFE 5-V, 4-A RECHARGEABLE POWER SUPPLY

John J. Sammarco 1989 19 p Sponsored by Bureau of Mines, Washington, DC

(PB90-103235; BUMINES-IC-9223; LC-88-607917) Avail: NTIS HC A03/MF A01 CSCL 09C

The U.S. Bureau of Mines has developed a regulated, intrinsically safe, rechargeable power supply for portable electronic equipment for underground use. The regulated output is ideal for microprocessor power requirements and is suited for operation in hazardous environments. Two rechargeable, sealed batteries are contained within the power supply. Provisions are made to use an external source of power if these batteries fail. Provisions are also made to charge these internal batteries when needed. The circuit is composed of three main circuits: the main regulator circuit, the input protection circuit, and the output protection circuit. The main regulator circuit provides remote voltage sensing, current sensing, fault monitoring, and internal thermal protection. The input protection circuit checks for excessive input current and low battery conditions. The output protection circuit contains two overvoltage detection devices. Schematics, a parts list, and a calibration procedure are provided in the report to enable readers to fabricate the power supply. GRA

N90-17007# Helsinki Univ. of Technology, Espoo (Finland). Radio Lab.

HIGH-EFFICIENCY SCHOTTKY-VARACTOR FREQUENCY MULTIPLIERS AT MILLIMETER WAVES Ph.D. Thesis

Timo Juhani Tolmunen Jun. 1989 20 p Sponsored by Academy of Finland

(PB90-110701; ISBN-951-754-918-0; ISSN-0355-5712) Avail: NTIS HC A03/MF A01 CSCL 09A

The thesis concentrates on varactor multipliers. A systematic study of frequency multipliers starting with a doubler proceeding through a tripler and a quadrupler up to a quintupler was carried out. The study starts with an analysis of the Schottky-varactor, proceeds through a design of the mount and ends with an experimental verification. The emphasis of the work is on the experimental verification of the existing theory. The theory enables the large-signal current and voltage waveforms to be determined for the Schottky-varactor in arbitrary conditions, i.e., without restrictions due to diode parameters, embedding impendances, bias voltage and fundamental oscillator power. A computer program based on the theory was modified and further developed to make it a convenient basic tool for multiplier analyses and optimization. The goal throughout the work was to find out design methods which are applicable for frequency multipliers at millimeter waves. GRA

N90-17008*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

THERMAL SWITCH DISC FOR SHORT CIRCUIT PROTECTION OF BATTERIES Patent Application

Eric C. Darcy, inventor (to NASA) and Bobby J. Bragg, inventor (to NASA) 27 Apr. 1989 13 p

(NASA-Case-MSC-21428-1; US-Patent-Appl-SN-343652; NAS 1.71:MSC-21428-1) Avail: NTIS HC A03/MF A01 CSCL 09A

A protective device for one battery or serially arranged battery cells is disclosed and is adapted to fit between one battery and its terminal connector or between adjacent battery cells. The device incorporates a disk of positive temperature coefficient material having a pair of circular end faces for contact. The disk is supported by a ring adhesively joined thereto, the ring having a central axial opening to enable the button terminal of a battery cell to contact against the disk as the disk and battery cell are arranged in a single battery application or in serial contact with similar battery cells. NASA

N90-17009*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

UNIVERSAL NONDESTRUCTIVE MM-WAVE INTEGRATED CIRCUIT TEST FIXTURE Patent Application

Robert R. Romanofsky, inventor (to NASA) and Kurt A. Shalkhauser, inventor (to NASA) 10 Aug. 1989 17 p

(NASA-Case-LEW-14746-1; US-Patent-Appl-SN-392239; NAS 1.71:LEW-14746-1) Avail: NTIS HC A03/MF A01 CSCL 09A

Monolithic microwave integrated circuit (MMIC) test includes a bias module having spring-loaded contacts which electrically engage member. RF frequency is applied to and passed from the chip carrier by chamfered edges of ridges in the waveguide passages of housings which are removably attached to the base member. Thru, Delay, and Short calibration standards having dimensions identical to those of the chip carrier assure accuracy and reliability of the test. The MMIC chip fits in an opening in the chip carrier with the boundaries of the MMIC lying on movable reference planes thereby establishing accuracy and flexibility. NASA

N90-17010*# National Aeronautics and Space Administration. Pasadena Office, CA.

SOLID STATE ELECTRICAL SWITCH EMPLOYING MATERIALS WITH REVERSIBLE PHASE TRANSISTORS Patent Application

Roger M. Williams, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 29 Sep. 1989 18 p (Contract NAS7-918)

(NASA-Case-NPO-17621-1-CU; NAS 1.71:NPO-17621-1-CU; US-Patent-Appl-SN-414820) Avail: NTIS HC A03/MF A01 CSCL 09A

A bistable switching element is made of a material whose electrical resistance reversibly decreases in response to intercalation by positive ions. Flow of positive ions between the bistable switching element and a positive ion source is controlled by means of an electrical potential applied across a thermal switching element. The material of the thermal switching element generates heat in response to electrical current flow therethrough, which in turn causes the material to undergo a thermal phase transition from a high electrical resistance state to a low electrical resistance state as the temperature increases above a predetermined value. Application of the electrical potential in one direction renders the thermal switching element conductive to pass electron current out of the ion source. This causes positive ions to flow from the source into the bistable switching element and intercalate the same to produce a non-volatile, low resistance logic state. Application of the electrical potential in the opposite direction causes reverse current flow which de-intercalates the bistable logic switching element and produces a high resistance logic state. NASA

N90-17011*# National Aeronautics and Space Administration. Pasadena Office, CA.
COPPER CHLORIDE CATHODE FOR A SECONDARY BATTERY Patent Application
Ratnakumar V. Bugga, inventor (to NASA), Salvador DiStefano, inventor (to NASA), Ganesan Nagasubramanian, inventor (to NASA), and Clyde P. Bankston, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 11 Sep. 1989 13 p (Contract NAS7-918)
(NASA-Case-NPO-17640-1-CU; NAS 1.71:NPO-17640-1-CU; US-Patent-Appl-SN-405169) Avail: NTIS HC A03/MF A01 CSCL 09A

Higher energy and power densities are achieved in a secondary battery based on molten sodium and a solid, ceramic separator such as a beta alumina and a molten catholyte such as sodium tetrachloroaluminate and a copper chloride cathode. The higher cell voltage of copper chloride provides higher energy densities and the higher power density results from increased conductivity resulting from formation of copper as discharge proceeds.
NASA

N90-17012# Institute of Electrical Engineers of Japan, Tokyo.
THE 1989 NATIONAL CONVENTION RECORD IEE JAPAN, PART 7
Apr. 1989 259 p In JAPANESE
(DE89-910080; IEEJ-8901) Avail: NTIS (US Sales Only) HC A12/MF A02

Articles are presented from the National Convention, I.E.E. Japan opened in April, 1989. The articles are reports on the static machine, application of superconductivity and electric railway section, and numerical analysis method of eddy current field and its verification model. The static machine section includes 79 articles: simulation of hysteresis curves under the existence of air-gap and calculation of magnetic field caused by circular ring coil and others. The application of superconductivity section includes 48 articles: characteristics of superconducting synchronous generator and design of nitrogen-cooled superconducting generator and others. The electric railway section includes 42 articles: radio noises caused by railways and prototype support system to decide renewal times for substation facilities and others. The symposium includes 6 articles: three-dimensional eddy current field analysis by A-phi method, three-dimensional eddy current field analysis by T-Omega method and others. DOE

N90-17013# Institute of Electrical Engineers of Japan, Tokyo.
THE 1989 NATIONAL CONVENTION RECORD IEE JAPAN, PART 8
Apr. 1989 328 p In JAPANESE
(DE89-910081; IEEJ-8902) Avail: NTIS (US Sales Only) HC A15/MF A02

Articles presented at the National Convention, I.E.E. Japan are documented. The articles of the electric power system section are recorded. The section includes 203 articles: Load frequency control by compensation-limited type controller; Robust control of hydraulic power station; Introduction of local FFC control; Study on application of on-load tap changers to frequency control; Design of adaptive load frequency control; Digitally redesigned LFC in consideration of GRC; Application of follow-up control with variable structure model to power systems; Calculation of demand and supply balance control by LP method; Coordination between ELD and LFC based on optimal control theory; Decentralized control of large scale power systems by disturbance observer and integrating optimal servo system; and Self-decentralizing system of power systems by coherent group and others. DOE

N90-17014# Institute of Electrical Engineers of Japan, Tokyo.
THE 1989 NATIONAL CONVENTION RECORD IEE JAPAN, PART 11
Apr. 1989 270 p In JAPANESE
(DE89-910083; IEEJ-8903) Avail: NTIS (US Sales Only) HC A12/MF A02

Articles are presented from the national convention, IEE Japan opened in April, 1989. The articles are records from the power cable and energy generation/conversion sections. The symposium emphasis was on: Current status of fuel cells for practical use. The power cable section includes 72 articles: Construction of the first 8,000A class 275kV compressed gas insulated (CGI) transmission line in the world; Antiseismic characteristics of CGI transmission terminating sets installed on transmission powers; Temperature rise characteristics of vertically laid CGI transmission lines and others. The energy generation/conversion section includes 77 articles: Estimation of solar radiation by meteorological satellite pictures; Errors of sunshine duration used for the application planning of solar thermal energy; Solar irradiance obtained through glass and vinyl and others. The symposium included 5 articles: Developmental conditions of phosphoric acid type fuel cells' and others. DOE

N90-17015# McElroy (Ralph) Co., Austin, TX.
A NEW TYPE OF RADIOLUMINESCENT LIGHT SOURCE
Laszlo Bursics, Tibor Forster, Andras Szabo, and Kalman Koller 1989 7 p Transl. into ENGLISH from Hungarian Patent No. Sho180-569 (30 Apr. 1984) Prepared in cooperation with Magyar Tudomanyos Akademia, Budapest (Hungary)
(DE90-004294; ALS/TR-89-20) Avail: NTIS HC A02/MF A01

This invention involves a radioluminescent light source, in which the radiation of a radioactive gas excites the luminescent material, made of a transparent material and located within a gastight coating. DOE

N90-17016# Central Research Inst. of Electric Power Industry, Tokyo (Japan). Energy and Environment Lab.
EVALUATION OF A PROTOTYPE LITHIUM MOLYBDENUM DISULFIDE SECONDARY BATTERY FOR LOAD CONDITIONER: CHARACTERISTICS AND PERFORMANCE OF 70Wh CLASS BC CELL
Kazuma Kumai, Toru Iwahori, Kaoru Ishihara, and Toshikatsu Tanaka Dec. 1988 49 p In JAPANESE; ENGLISH summary
(DE90-702460; CRIE-T-88011) Avail: NTIS (US Sales Only) HC A03/MF A01

A 70 Wh prototype lithium molybdenum disulfide secondary battery developed by Moli Energy Limited, Canada has high energy density, and it can possibly be used as a load conditioner battery. Evaluations on the performance of the cell and its applicability as a load conditioner, were carried out through charge-discharge cycle tests (eight hours rate). The test condition is based on the design of the load conditioner. The basic performance of the cell, such as energy density, energy efficiency, charge-discharge profile, are acceptable. However, its cycle life needs to be made longer for use as a load conditioner. The following seem to be the causes of deterioration: deterioration of the performance of the cell components such as positive electrode, electrolytes, separators; and deterioration of the performance of the lithium negative electrode due to the formation of dendrites and the isolation of plated Li. DOE

N90-17017# Institute of Applied Energy, Tokyo (Japan).
OUTLOOK FOR NEW ENERGIES. SECONDARY BATTERIES
Mar. 1989 32 p In JAPANESE
(DE90-734946; TIAE-8902) Avail: NTIS (US Sales Only) HC A03/MF A01

New energies are defined as all kinds of energies which can be expected to be put to practical use as the result of future technological development. Among new energies, secondary batteries are very much desired to be developed for use with electric vehicles, electric load leveling, output stabilization of solar power and wind power generation, etc. Secondary batteries are outlined, and the development situation and problems of various new batteries expected to be used in the field of energy are introduced. Standard specifications, performance, and applications of secondary batteries are briefly introduced. The research and development activities in Japan, U.S.A. and Europe are reported. Descriptions are made on the redox flow battery, nickel-iron battery, zinc-bromine battery, zinc-chrome battery, metal-air battery, and other new type batteries. Lastly, the future outlook in the field of secondary batteries is reported. DOE

N90-17018# Central Research Inst. of Electric Power Industry, Tokyo (Japan). Energy and Environment Lab.
RESEARCH AND DEVELOPMENT OF LITHIUM/POLYANILINE BATTERY, PART 2
K. Takei, Kaoru Ishihara, and Toru Iwahori May 1989 28 p In JAPANESE; ENGLISH summary
(DE90-734985; CRIE-T-88059-Pt-2) Avail: NTIS (US Sales Only) HC A03/MF A01

As a secondary battery for load conditioner use, a lithium/polyaniline battery was found to have high energy density by the following two techniques: (1) With a higher concentration of electrolyte, it was found that the cell performance had little changes between 0.95 to 2.25 mol/l. As a result, the lithium/polyaniline battery with high concentration electrolyte was thought to have higher energy densities than before; (2) Cathode capacity is expected to increase when charge potential goes from 4.0V to 4.5V. It was clear that the capacity increased about 1.4 times in initial cycles but that it decreased with cycles, and coulombic efficiency went from 100 to 96 percent. The loss of coulombic efficiency was caused by the degradation of polyaniline. The polyaniline needs to be stabilized, through a change in properties, in a high potential region. DOE

N90-17019# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
SOLID STATE MICROELECTROCHEMICAL DEVICES: TRANSISTOR AND DIODE DEVICES EMPLOYING A SOLID POLYMER ELECTROLYTE Technical Interim Report No. 32, 1 Jul. - 1 Oct. 1989
Daniel R. Talham, Richard M. Crooks, Vince Cammarata, Nicholas Leventis, Martin O. Schloh, and Mark S. Wrighton 1 Oct. 1989 11 p Submitted for publication Sponsored in part by Lockheed Missile and Space Corp. and DARPA
(Contract N00014-84-K-0553)
(AD-A214206) Avail: NTIS HC A03/MF A01 CSCL 09/1

Not long ago this group first described micro electrochemical devices which are based on microfabricated arrays of electrodes connected by electroactive materials. Because the active components of these devices are chemical in nature, many of these devices are chemically sensitive and comprise a potentially useful class of chemical sensors. Devices showing sensitivity to pH, O2, H2, Li, and Na have been demonstrated. These devices, typically operated in fluid solution electrolytes, need to be developed. We have recently reported solid state microelectrochemical transistors which replace conventional liquid electrolytes with polymer electrolytes based on polyethyleneoxide (PEO) and polyvinylalcohol (PVA). GRA

N90-17020# Stanford Univ., CA. Dept. of Electrical Engineering.
TO CONSTRUCT A LINAC/STORAGE RING FEL FACILITY Final Report, 15 Dec. 1983 - 14 Jul. 1988
John M. Madey Aug. 1989 7 p
(Contract F49620-84-C-0012)
(AD-A214620; AFOSR-89-1311TR) Avail: NTIS HC A02/MF A01 CSCL 20/7

Gomponents of a 1GeV electronic storage ring and linac injector were designed, studied, and evaluated. The principal objective was to the development of a high brightness storage ring and linac injector for use in advanced Extreme Ultraviolet Free Electron Laser and synchrotron radiation research and as a source of high brightness electron beams for the development of other advanced short wavelength radiation sources. The list of components developed with AF-12 support include: (1) a high brightness microwave gun for the linac injector; (2) a long pulse high power modulator for the linac injector; (3) a short pulse high power modulator for the linac; (4) the control chassis for the long and short pulse modulators; (5) a high power pressurized waveguide feed system for the SLAC-type S-Band accelerator sections; (6) quadrupole lenses for the linac; (7) mechanical supports and alignment fixtures for the linac's accelerator sections; (8) the dipole, quadrupole, and sextupole magnets for the ring; (9) the water cooled vacuum chambers for the arcs of the ring; and (10) the beam position monitors for the arcs of the ring. GRA

N90-17021# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
THEORETICAL ANALYSIS OF MICROWAVE AND MILLIMETER WAVE INTEGRATED CIRCUITS BASED ON MAGNETIC FILMS Annual Report, 1 Oct. 1988 - 30 Sep. 1989
J. A. Kong 20 Nov. 1989 21 p
(Contract N00014-89-J-1019)
(AD-A214772) Avail: NTIS HC A02/MF A01 CSCL 09/1

The complex resonant frequencies of the open structure of a microstrip antenna consisting of two circular microstrip disks in a three layer stacked configuration have been rigorously calculated as a function of the layered parameters and the ratio of the radii of the two disks. It is shown that for each mode, the stacked circular microstrip structure has dual resonant frequencies which are associated with the two coupled constitutive resonators of the structure and which are a function of the mutual coupling between them. The dual frequency behavior of the stacked microstrip structure, easily controlled by varying the parameters of layer 2 and disk radii ratio, given fixed parameters for layer 1 and layer 3, may be used to broaden the bandwidth or provide for dual frequency use of the antenna. GRA

N90-17022# Georgia Inst. of Tech., Atlanta. School of Electrical Engineering.
ELECTROMAGNETIC SCALE MODELS USING EMULSIONS Final Report, Dec. 1986 - Apr. 1988
Glenn S. Smith and Waymond R. Scott, Jr. Apr. 1989 49 p
(Contract F30602-81-C-0185)
(AD-A214855; RADC-TR-89-4) Avail: NTIS HC A03/MF A01 CSCL 20/3

The electrical constitutive parameters of materials in a scale model and the corresponding full-sized system must satisfy certain relationships. Thus, it is desirable to have a series of materials with a range of electrical parameters or mixtures of materials with adjustable electrical parameters for use in scale models. Simple emulsions are examined as materials with adjustable electrical constitutive parameters. These emulsions are mixtures of soil, saline solution, and a suitable stabilizing agency (emulsifier). Since the relative permittivities of oil and water are around two and eighty, respectively, a large range of permittivity can be obtained for the emulsions. The conductivity of the emulsions can be adjusted by changing the normality of the saline solution. A series of oil-in-water emulsions (oil droplets in water), suitable for use in scale models, is developed; this includes the selection of an appropriate emulsifier. The electrical constitutive parameters of these emulsions are adjustable over wide ranges, and are predictable from a simple formula. As an example, an emulsion that is a scale model for red clay earth is described. This emulsion matches the electrical constitutive parameters of the clay, including the dispersion in the conductivity, over a ten-to-one frequency range. GRA

N90-17023# Texas A&M Univ., College Station. Dept. of Electrical Engineering.
MODELING ANTENNAS AND SCATTERERS OF ARBITRARY SHAPE EMBEDDED IN LAYERED DIELECTRIC MEDIA Final Report
Krzysztof A. Michalski 30 Nov. 1989 147 p
(Contract N00014-87-K-0688)
(AD-A214902) Avail: NTIS HC A07/MF A01 CSCL 09/1

A general approach is developed for the rigorous analysis of radiation, scattering, and guidance of electromagnetic fields by conducting objects for arbitrary shape embedded in layered dielectric media. This approach is based on the mixed potential form of the electric field integral equation, which is amenable to the existing, well established numerical solution procedures, originally developed for objects in homogeneous space. Numerical results are presented for surfaces and wires that penetrate an interface between dissimilar media and for open microstrip

transmission lines of finite thickness. Computed and measured data are also given for coax-fed rectangular and triangular microstrip patch antennas. GRA

N90-17024# Army Lab. Command, Watertown, MA. Material Technology Lab.
THE DESIGN OF LOW INDUCTANCE ELECTRICAL CIRCUITS FOR SLAPPER DETONATOR SYSTEMS
Don D. Richardson and Ross Kummer Apr. 1989 30 p
(AD-A214981; MRL-TR-89-7; DODA-AR-005-691) Avail: NTIS HC A03/MF A01 CSCL 10/2

Flying plate generators (FPG) are used to study the shock properties of various materials. This report investigates the theoretical electrical properties of the flat, parallel conductors that are currently used in the construction of FPGs. The design of these conductors can greatly effect the efficiency of FPGs by varying the high frequency capacitance and inductance of the electrical circuit, and the induced current in the surrounding system. The report derives rules governing the geometry of the conductors to minimize the inductance and capacitance of high frequency for such circuits. GRA

N90-17025# Naval Research Lab., Washington, DC. Search Radar Branch.
INTERFERENCE REJECTION AND DETECTION PERFORMANCE OF THE SMALLEST OF CIRCUIT Interim Report
George J. Linde 29 Nov. 1989 10 p Sponsored by Space and Naval Warfare System, Washington, DC
(AD-A215153; NRL-9243) Avail: NTIS HC A02/MF A01 CSCL 17/9

Radar systems encounter severe interference when other nearby systems operate on the same frequency. Usually, this type of interference is eliminated with a binary integrator or M-out-of-N detector. The loss of amplitude information is a disadvantage incurred with this type of detector; also the detection performance is worse than that of a detector that integrates the signal prior to thresholding. This report describes the means of eliminating asynchronous interference by amplitude comparison of consecutive radar sweeps; the smaller of the two is retained. Interference is eliminated, amplitude information is retained, and the detection performance is shown to be only 0.7 dB worse than that of a moving window integrator. GRA

N90-17026# Aerospace Corp., El Segundo, CA. Electronics Research Lab.
OPTIMIZATION OF THE INTERMODULATION PERFORMANCE OF GaAs MESFET SMALL-SIGNAL AMPLIFIERS
Stephen A. Maas and Andrea M. Crosmun 30 Sep. 1989 20 p
(Contract F04701-88-C-0089)
(AD-A215193; TR-0089(4925-02)-2; SD-TR-89-74) Avail: NTIS HC A03/MF A01 CSCL 09/1

Matching conditions that optimize the third-order intermodulation distortion of small-signal MESFET amplifiers, subject to available-gain criteria, are derived. A numerical formulation of the Volterra series is used in conjunction with a complete equivalent circuit of the FET. The sensitivity of IP(3) to gamma (s) decreased with frequency and can be related to the MESFET's stability. GRA

N90-17027# Army Lab. Command, Fort Monmouth, NJ. Electronics Technology and Devices Lab.
POLARIZATION MATRICES OF QUARTZ Technical Report, Jan. 1988 - Jan. 1989
Arthur Ballato and Theodore Lukaszek Jul. 1989 26 p
(AD-A215198; SLCET-TR-89-5) Avail: NTIS HC A03/MF A01 CSCL 09/1

In analytical treatments of piezoelectric-acoustic transducers, signal processors, and resonators, the electromechanical transduction mechanism is most often expressed in terms of the elements of the piezoelectric (e) or (d) matrices. Molecular interpretations of piezoelectricity, and especially electrooptical applications, usually involve polarization as the preferred variable, and consequently the alternative (a) and (b) matrices are of interest. The elements of these latter sets are calculated for quartz from measured elastopiezodielectric constants taken from the literature. GRA

N90-17028# Army Lab. Command, Fort Monmouth, NJ. Electronics Technology and Devices Lab.
QUARTZ CRYSTAL RESONATOR MASS LOADING Technical Report, Jan. 1988 - Jun. 1989
John Kosinski, Arthur Ballato, and S. Mallikarjun (Monmouth Coll., West Long Branch, NJ.) Aug. 1989 28 p
(AD-A215199; SLCET-TR-89-7) Avail: NTIS HC A03/MF A01 CSCL 09/1

Ongoing work aimed at determining the physical properties of cultured quartz material from frequency measurements of bulk wave resonators has highlighted the need for accurate means of measuring the mass loading due to the electrodes. Various methods of determining electrode mass loading are presented, and measurements of mass loading using several of these techniques are compared. Variations between the values of mass loading obtained by the various techniques are discussed and a model is proposed to explain the various differences. GRA

N90-17029# SoHaR, Inc., Los Angeles, CA.
SNEAK CIRCUIT ANALYSIS FOR THE COMMON MAN Interim Report, Oct. 1987 - Jan. 1989
Jeff Miller Oct. 1989 48 p
(Contract F20602-87-C-0193)
(AD-A215275; RADC-TR-89-223) Avail: NTIS HC A03/MF A01 CSCL 09/1

This report presents the process known as sneak circuit analysis in a simple, easy to follow format. A listing of common design mistakes which led to sneak failures is given. This listing coupled with examples and descriptions of the design flaws, allow this document to be used not only to check an existing system, but more importantly, to correct a system in the design phase. This will save the expense of correcting a mistake discovered later in the development of a system. GRA

N90-17030# Aerospace Corp., El Segundo, CA. Electronics Research Lab.
MODELING THE GATE I/V CHARACTERISTIC OF A GaAs MESFET FOR VOLTERRA-SERIES ANALYSIS
Stephen A. Maas and Andrea M. Crosmun 30 Sep. 1989 16 p
(Contract F04701-85-C-0086)
(AD-A215314; TR-0088(3925-02)-2; SD-TR-89-72) Avail: NTIS HC A03/MF A01 CSCL 09/1

It is shown that the Taylor-series coefficients of a FET's gate/drain I/V characteristic, which are used to model the I/V nonlinearity for Volterra-series analysis, can be derived from low-frequency RF measurements of harmonic output levels. The method circumvents many of the problems that occur when dc measurements are used to characterize this nonlinearity. GRA

N90-17031# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
SILICON HYBRID WAFER SCALE INTEGRATION INTERCONNECT EVALUATION M.S. Thesis
James C. Lyke Dec. 1989 415 p
(AD-A215353; AFIT/ENG/GE/89D-27) Avail: NTIS HC A18/MF A03 CSCL 09/1

The electrical characteristics of interconnections that have been proposed for use in silicon hybrid wafer scale integration (WSI) approaches were investigated. The study was based on a set of 5 inch test wafers, containing various interconnection structures previously designed at AFIT. Two test wafers used a special polyimide dielectric, while a third was composed of a benzocyclobutene (BCB). The investigated structures represented 10 cm length aluminum, coupled, stripline-like transmission lines. The metrics used included continuity measurements, ac measurement of the characteristic impedance and coupling levels, and pulsed-signal response measurements. Continuity results indicated transmission and leakage failures in all wafers, although

the failure mechanisms were sometimes wafer-specific. The characteristic impedance measurement technique was flawed, but revealed interesting information concerning the driving-point impedances of the structures. Most coupled structures manifested coupling responses which were consistent in shape with theoretical estimates, but higher in magnitude by 10 to 20 dB. All structures revealed coupling levels lower than -25 dB. Despite correlation difficulties, the results implied that transmission line behavior is manifested in WSIC interconnections. GRA

N90-17032# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
A DISTRIBUTED KERNEL FOR SIMULATION OF THE VHSIC HARDWARE DESCRIPTION LANGUAGE M.S. Thesis
Michael Chris Proicou Dec. 1989 124 p
(AD-A215419; AFIT/GCS/ENG/89D-14) Avail: NTIS HC A06/MF A01 CSCL 12/7

A technique is developed for simulating large scale circuit models, written in the Very High Speed Integrated Circuit Hardware Description Language (VHDL), on a distributed computer composed of many individual processing units. The distributed system consists of a scalable kernel which can support a large simulation composed of many concurrent VHDL processes. The kernel provides model-independent support functions that handle signal propagation and process activation in a distributed environment. The synchronization between individual logical processes in the kernel is handled using the Chandy-Misra null message algorithm. The distributed kernel was implemented using the Spectrum distributed simulation testbed and runs on the eight-processor Intel iPSC/2 Hypercube at AFIT. Several test circuits were simulated, including ripple-carry and carry look-ahead adders, and a counter. These cases cover combinational and sequential logic. GRA

N90-17033# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
DEVELOPMENT OF THE KALMAN FILTER APPLICATION AND A VHDL MODEL FOR THE AFIT (AIR FORCE INSTITUTE OF TECHNOLOGY) FLOATING POINT APPLICATION SPECIFIC PROCESSOR (FPASP) M.S. Thesis
William E. Koch Dec. 1989 157 p
(AD-A215423; AFIT/GCE/ENG/89D-3) Avail: NTIS HC A08/MF A01 CSCL 09/1

The Air Force Institute of Technology (AFIT) is conducting research that will lead to the development of a Floating Point application Specific Processor (FPASP). The FPASP architecture is designed around two independent 32 bit data paths that work in tandem to support full IEEE double precision floating point operations, or that can work independently for 32 bit integer processing. Designed to operate at 25 MHz, the FPASP will be capable of performing 25 million floating point operations per second. A rapid prototyping methodology has been developed for the FPASP. A user identifies an application that could benefit from a VLSI solution. An algorithm of the application is translated into FPASP microcode which can then be programmed into the Laser Programmable Read Only Memory (LPROM) of a blank FPASP. The programmed FPASP can then be mounted on a circuit card and installed in a host system where it would function as a hardware accelerator supporting the user application. In the first part of this thesis, a user application, the Kalman Filter algorithm, is translated into FPASP microcode for programming into the FPASP. In part two, the feasibility of using the VHSIC (Very High Speed Integrated Circuitry) Hardware Design Language (VHDL) to model a complete system is demonstrated by developing a register transfer level model of the FPASP. GRA

N90-17034# Texas Univ., Austin. Microwave Lab.
A STUDY OF A NEW TIME-DOMAIN METHOD OF LINES AND ITS APPLICATION FOR THE CHARACTERIZATION OF MICROSTRIP LINE AND ITS DISCONTINUITIES
Sangwook Nam, Hao Ling, and Tatsuo Itoh May 1989 107 p
(Contract N00014-89-J-1006)
(AD-A215441; MW-89-P-3) Avail: NTIS HC A06/MF A01 CSCL 20/14

A new time domain method for the analysis of planar guided wave propagation and scattering is developed in which an analytical process is incorporated along one of the spatial dimensions. The method makes use of the Method of Lines which has been applied to microwave problems in the time-harmonic cases. The procedure and the formulation of the proposed method to calculate the time history of a pulse scattered in a partially filled waveguide and a finned waveguide are described in detail. The cutoff characteristics of the structures can be derived via the Fourier transform of the time-domain pulse scattering data. The results are compared with other available data. The method is extended to characterize 3-D structures. The procedure and the formulation of the 3-D analysis are explained. The propagation and scattering data of a pulse in a planar transmission line with its discontinuities can be obtained by using the 3-D analysis. From the time domain data, the frequency-domain characteristics for a wide range of frequencies can be extracted by the Fourier transform. The important design parameters such as the characteristic impedance and the propagation constant of a uniform microstrip line and the scattering parameters of its discontinuities (step-in-width, open end and gap discontinuities) are presented and compared with available published data. GRA

N90-17035# Naval Civil Engineering Lab., Port Hueneme, CA.
THE 25-KVA AMORPHOUS METAL-CORE TRANSFORMER DEVELOPMENTAL TEST REPORT Final Report, FY 1987 - FY 1988
G. V. Urata, J. O. Franchi, and P. E. Franchi Aug. 1989 204 p
Sponsored by Naval Facilities Engineering Command, Alexandria, VA and ONR, Arlington, VA
(AD-A215444; NCEL-TN-1801) Avail: NTIS HC A10/MF A02 CSCL 10/2

NCEL has completed a test and evaluation program for 25-kVA amorphous metal-core transformers. These transformers save energy by reducing no-load losses by 60 to 70 percent. No-load losses are estimated to cost the Navy millions annually and if all of the Navy transformers were replaced by amorphous metal-core transformers, the Navy would save millions a year. The program objective was to evaluate the electrical performance and operational reliability of the amorphous metal-core transformers compared to conventional silicon-steel transformers. GRA

N90-17036# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
TESTING AND DATA PATH REDESIGN OF A HIGH SPEED, 16-POINT WINOGRAD FOURIER TRANSFORM PROCESSOR M.S. Thesis
Steven W. Pavick Dec. 1989 139 p
(AD-A215661; AFIT/GE/ENG/89D-39) Avail: NTIS HC A07/MF A01 CSCL 09/1

A prototype 16-point, 70 MHz Fourier transform processor using 1.2 micron minimum feature sizes was tested using a Tektronix DAS 9200, digital analysis system. The results showed that it is possible to operate an Air Force Institute of Technology (AFIT) WFT16 chip at 70 MHz. The results also showed a great deal of variation among the individual packaged chips. Using the WFT16's built in testing circuitry, portions of the main data and control circuitry were tested. The AFIT XROM address generator and control circuitry proved to be the most reliable chip subsection, followed by the arithmetic and register control system. The parallel-in serial-out input data register was also tested and showed consistent results even though the results were not as expected. The variation among chips was shown when attempts at trivial transforms were done. The attempted transforms consisted of dc data values of zero and minus one. Two of 16 tested chips showed correct transform values, but for only a limited, nonrepeated sequence. In later testing, two chips were found that gave repeatable results which closely approximated the expected results for both trivial and nontrivial transform attempts. Test procedures and input to output relationships were determine to aid further testing of the AFIT WFT16 circuit. GRA

N90-17037# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
EVALUATION OF DOPED PHTHALOCYANINES AND A CHEMICALLY-SENSITIVE FIELD EFFECT TRANSISTOR FOR DETECTING NITROGEN DIOXIDE M.S. Thesis
Thomas J. Jenkins 4 Dec. 1989 334 p
(AD-A215662; AFIT/GE/ENG/89D-18) Avail: NTIS HC A15/MF A02 CSCL 07/3

The design and fabrication of an integrated circuit microsensor for the detection of nitrogen dioxide is examined. Metal-doped phthalocyanine compounds were evaluated as a candidate chemically sensitive membrane, and their performance was compared with respect to sensitivity, reversibility, and specificity. The microsensor consisted of the integration of an array of 9 sensing elements with amplifiers, a reference amplifier, and an analog multiplexer. The 9 individual sensing elements used an interdigitated gate electrode field effect transistor (IGEFET) coupled to a serially connected pair of inverting amplifiers using metal oxide semiconductor field effect transistors(MOSFETs). The interdigitated gate electrodes were coated with thin films of cobalt (II) phthalocyanine (CoPc), copper phthalocyanine (CuPc), lead phthalocyanine (PbPc), nickel (II) phthalocyanine (NiPc), and (undoped) phthalocyanine (Pc). An excitation signal was applied to the integrated circuit, and the multiplexed electrical response was measured in the time-domain and the frequency-domain. The electrical response was evaluated upon exposure to 20-, 80-, and 320-ppb of nitrogen dioxide (NO2) and diisopropyl methylphosphonate (DIMP) using filtered room air (less than 5 percent relative humidity) as the diluent. The electrical response was evaluated for film thickness of approximately 1500 A and 500 A. The rank ordering of the sensitivity of the materials to nitrogen dioxide from the most to least sensitive was: CoPc, NiPc, CuPc, PbPc, and then (undoped) Pc. GRA

N90-17038# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
A CIRCUIT EXTRACTION SYSTEM AND GRAPHICAL DISPLAY FOR VLSI (VERY LARGE SCALE INTEGRATED) DESIGN M.S. Thesis
Stuart A. Yarost Dec. 1989 124 p
(AD-A215668; AFIT/GCE/ENG/89D-9) Avail: NTIS HC A06/MF A01 CSCL 09/1

A system is proposed for higher order logic extraction of components from a net-list of transistors and the graphical display of the extracted components. Critical sections were implemented to demonstrate the feasibility of the system. These sections include a prototype expert system written in CLIPS and a graphical display capable of displaying extracted components on a Sun workstation. Extraction techniques which were developed use pattern matching and multiple passes. Graphical techniques used in the display include simple line drawing and translation of images. This research has the potential to provide savings of time and effort to engineers designing new circuits or reverse-engineering older circuits for which no adequate specifications exist. This system will also help to close the design cycle and allow the designer to assure that what he has physically designed is what he has logically designed. GRA

N90-17039# Sandia National Labs., Albuquerque, NM. Primary Standards Lab.
CHANGES IN THE VOLT, OHM, AND TEMPERATURE AND LONG RANGE IMPACT OF USING THE JOSEPHSON VOLTAGE STANDARD
Stuart L. Kupferman Dec. 1989 24 p
(Contract DE-AC04-76DP-00789)
(DE90-004493; SAND-89-2610) Avail: NTIS HC A03/MF A01

Important information is contained on the internationally mandated changes in the unit of the Volt and Ohm which will come into force on January 1, 1990; on how the Primary Standards Laboratory will respond to these changes, and recommendations on how the Contractor Standards Laboratories should respond to these changes. It also contains information about the new Josephson Voltage Standard that is now in operation at the Primary Standards Laboratory, and how the use of this standard will change the way that the Volt is disseminated to the Contractor Standards Laboratories. DOE

N90-17040# Argonne National Lab., IL. Chemical Technology Div.
SEALING L-ALLOYS/FeS(x) CELLS FOR A BIPOLAR BATTERY
T. D. Kaun, K. R. Gillie, M. J. Duoba, and J. A. Smaga 1989 12 p Presented at the Electrochemical Society Fall Meeting, Hollywood, FL, 15-20 Oct. 1989
(Contract W-31-109-eng-38)
(DE90-004887; CONF-8910107-8) Avail: NTIS HC A03/MF A01

Progress in cell design and materials development has led to the initial tests of sealed Li-alloy/metal sulfide cells for a bipolar battery configuration. Earlier efforts attempted to contain the molten electrolyte by a compressed peripheral gasket. The innovative design approach is to build the cell around a hermetic peripheral seal. This seal consists of metal components bonded to an insulating ceramic ring (e.g., MgO). Prototypic seals maintained secure bonds and showed little apparent reactivity in compatibility tests conducted for more than 1000 h at 450 C in melts with high lithium or sulfur activity. Single sealed FeS bipolar cells were operated for 1000 h and 100 cycles. Efforts are now being concentrated on the Li-alloy/FeS2 bipolar cell with molybdenum positive electrode current collector. Seal compositions that have a good matching of thermal expansion coefficient with molybdenum were developed. Over a dozen seals consisting of steel/ceramic/molybdenum were fabricated based on a 3 cm diameter, bipolar cell design. The bipolar battery is expected to double specific power and increase specific energy by 30 percent over the monopolar battery configuration for (gt)500 W/kg and 200 Wh/kg in an electric-vehicle application. DOE

N90-17041# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
ELECTRICAL TEST OF GYROTRON COIL
Yoshiyuki Aso, Julio Guimaraes Ferreira, and Jose Osvaldo Rossi Sep. 1989 33 p
(INPE-4929-RPE/596) Avail: NTIS HC A03/MF A01

Electrical test of one pancake coil of gyrotron was made. The result shows that the resistance of the coil for dc current with ripple is so different from the one of dc current without ripple that it heats the coil much more than the expected value. This difference was explained taking account of the eddy current effect. Author

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N90-17042*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AN UPWIND-BIASED, POINT-IMPLICIT RELAXATION ALGORITHM FOR VISCOUS, COMPRESSIBLE PERFECT-GAS FLOWS
Peter A. Gnoffo Washington Feb. 1990 75 p
(NASA-TP-2953; L-16588; NAS 1.60:2953) Avail: NTIS HC A04/MF A01 CSCL 20D

An upwind-biased, point-implicit relaxation algorithm for obtaining the numerical solution to the governing equations for three-dimensional, viscous, compressible, perfect-gas flows is described. The algorithm is derived using a finite-volume formulation in which the inviscid components of flux across cell walls are described with Roe's averaging and Harten's entropy fix with second-order corrections based on Yee's Symmetric Total Variation Diminishing scheme. Viscous terms are discretized using central

differences. The relaxation strategy is well suited for computers employing either vector or parallel architectures. It is also well suited to the numerical solution of the governing equations on unstructured grids. Because of the point-implicit relaxation strategy, the algorithm remains stable at large Courant numbers without the necessity of solving large, block tri-diagonal systems. Convergence rates and grid refinement studies are conducted for Mach 5 flow through an inlet with a 10 deg compression ramp and Mach 14 flow over a 15 deg ramp. Predictions for pressure distributions, surface heating, and aerodynamics coefficients compare well with experiment data for Mach 10 flow over a blunt body. Author

N90-17043 Manchester Univ. (England).
TURBULENT HEAT AND MOMENTUM TRANSFER IN RECIRCULATING AND IMPINGING FLOWS Ph.D. Thesis
Christopher R. Yap 1987 344 p
Avail: Univ. Microfilm Order No. BRD-84992

Evaluated here is the performance of current near-wall and turbulence models in computing turbulent heat and momentum transfer in recirculating and impinging flows. The effect on the computations of a novel wall-damping term in the energy dissipation rate equation is also assessed. Computations of the flow downstream of an abrupt pipe expansion (the principal test flow) are compared with detailed velocity, temperature and heat transfer data obtained by the writer as part of a collaborative effort between the Thermo-Fluids groups at UMIST and the University of California, (U.S.A.). Computations made using the kappa-epsilon model and Algebraic Stress Model (ASM) with wall functions are found to have serious shortcomings. In particular, the models fail to produce the Reynolds number (Re sub D) dependence of the heat transfer rates shown in experiments. The use of a one-equation model with a fine grid near the wall and the kappa-epsilon model in the outer region results in the reattachment length in better agreement with the experimental data. However, there is no improvement in producing the Re sub D dependence of the Nusselt number seen in experiments. When the low Reynolds number (LRN) kappa-epsilon model is used with a fine grid near the wall, the peak heat transfer rates are five times higher than the experimental values. Dissert. Abstr.

N90-17044 Sussex Univ., Brighton (England).
COMPUTATION OF FLUID FLOW AND HEAT TRANSFER IN ROTATING DISC-SYSTEMS Ph.D. Thesis
Chew-Lan Ong 1988 358 p
Avail: Univ. Microfilms Order No. BRDX86096

Described here is a numerical investigation into the turbulent flow and heat transfer characteristics in rotating disc systems. Particular emphasis has been given to the study of a rotating cylindrical cavity with a radial outflow of fluid which provides a simple model of the flow between two corotating air-cooled gas-turbine discs. Study is also made of the free disc, a single disc rotating in an infinite quiescent environment. The main effort has been devoted to the development and application of a suite of computer programs for the solution of the momentum and energy equations governing the highly-skewed boundary layers on the discs, for both incompressible and compressible flows. An accurate and efficient solution procedure has been devised, based on the Keller-Box finite-difference scheme, and a noniterative method for the determination of the pressure field implemented. Serious numerical problems associated with the reverse flows in the nonentraining Ekman-type layer have been successfully overcome. Turbulence has been modelled using both isotropic and anisotropic eddy-viscosity/mixing length formulations, the use of a low-Reynolds-number k-epsilon turbulence model proving unsatisfactory. Predictions of the velocity distributions inside the Ekman layer and in the inviscid core of the rotating cavity have been compared with extensive laser-Doppler-anemometry measurements. Dissert. Abstr.

N90-17045 Stanford Univ., CA.
AN EXPERIMENTAL STUDY OF THE EFFECT OF STREAMWISE VORTICES ON UNSTEADY TURBULENT BOUNDARY-LAYER SEPARATION Ph.D. Thesis
William Warren Humphreys 1989 271 p
Avail: Univ. Microfilms Order No. DA8919434

This experiment studied the effect of embedded streamwise vortices on unsteady turbulent boundary-layer separation. The objectives were to document the flow field, to characterize the time response of the boundary layer, and to understand the actual mechanisms by which the streamwise vortices modify boundary-layer behavior. A new configuration for non-obtrusive three-component Laser Doppler Anemometry (LDA) determined the phase averaged velocity and Reynolds stress components, in an unsteady water tunnel, at a momentum thickness Reynolds number of 1840. The stream-wise vortices were created by three pairs of half-delta wing vortex generators, while the boundary-layer separation was controlled through impulsively initiated opposite-wall suction, which created a strong adverse pressure gradient. The time response of the freestream velocity demonstrates that convection is the primary mechanism by which vortex generators modify the response of the boundaty layer. Modeling the response with two time scales proved to be a useful technique. There is an initial fast response throughout the boundary layer which is unaffected by the presence of vortex generators, followed by a slow or convective response, the magnitude of which is substantially modified by the presence of the vortex generators. Dissert. Abstr.

N90-17046 Oklahoma State Univ., Stillwater.
AN EXPERIMENTAL AND ANALYTICAL EXAMINATION OF STRATIFIED THERMAL STORAGE Ph.D. Thesis
Yousef Hasan Zurigat 1988 178 p
Avail: Univ. Microfilms Order No. DA8915052

This study has been undertaken to investigate the design improvements of single stratified thermal storage tanks for achieving high performance under a wide range of flow conditions and inlet configurations. Both constant and variable inlet temperature conditions were examined using both experimental and analytical approaches. Extensive experiments with thermocline (constant inlet temperature) thermal storage were conducted using fresh-saline and hot-cold water systems for three different types of inlets. Under constant inlet temperature conditions, the results of the experimental and analytical studies suggest the existence of a limiting Richardson number above which the influence of the inlet geometry on stratification in thermocline thermal energy storage vanishes. A value of Richardson number of 9.0 was deduced. Also, turbulent mixing correlations for three different inlets were obtained and a highly accurate one-dimensional flow model was developed. The predictions of the model showed a good agreement with experimental data obtained in this study and from literature. For the case of variable inlet temperature conditions, the use of the flow distributors of the type investigated here offer no advantage over the conventional inlets. However, the versatile two-dimensional model developed here offers the tool for investigating a wide variety of inlet geometries. Dissert. Abstr.

N90-17047 Clemson Univ., SC.
IMPINGEMENT CHARACTERISTICS OF HEATED PLANE TURBULENT JETS Ph.D. Thesis
Raghunath Gopal Menon 1989 165 p
Avail: Univ. Microfilms Order No. DA8922939

The characteristics of the impingement region of plane turbulent heated jets were studied. Turbulent jet impingement, as evidenced by the data in the literature, enhances the surface heat transfer rates considerably. This enhancement is seen to be marked when the impingement distance is of the order of the extent of the potential core of the jet. The primary purpose of this investigation was to identify those turbulence characteristics of the flow which may lead to the enhancement of surface heat transfer rates in the impingement region. The impingement characteristics are examined for both near and far region impingement. The local velocity (two components) was measured using a directionally

sensitive LDA system. The local temperature was measured using a fine wire resistance probe using a constant current circuit. The mean flow and thermal characteristics indicate the impingement region to be well mixed. This region typically extends away from the plate approximately 20 percent of the impingement distance. The local longitudinal turbulence intensity was seen to rise rapidly in the impingement region. This rise is much larger for far region impingement. Dissert. Abstr.

N90-17048 Virginia Polytechnic Inst. and State Univ., Blacksburg.
NEW MIXING-LENGTH MODEL FOR NUMERICAL SOLUTION OF TURBULENT SUPERSONIC FLOWS Ph.D. Thesis
Ming Situ 1989 159 p
Avail: Univ. Microfilms Order No. DA8913755

An attempt has been made to find a new mixing-length model which will account for the effects of compressibility on the turbulence. Through an analysis of the Reynolds-stress formula and following the ideas of Prandtl's original mixing-length hypothesis, the effort has essentially been directed to classes of compressible flow problems where there exist large changes of density and Mach number. The new mixing-length model which has been found here is a generalization to include gradients of Mach number, pressure and density; and the local parameters values, such as speed of sound, density, Mach number, ratio of specific heats and a new parameter S which is introduced in the new turbulent transport formula. The new parameter S acts like an effective turbulent Schmidt Number for mixtures of gases or a turbulent Prandtl Number for a homogeneous gas. The new turbulent model and Prandtl's original model are both applied to six test cases including: tangential slot injection problems, the very complex cases of shock-wave/turbulent shear-layer and boundary layer interactions, and high Mach number turbulent boundary layer flows over a flat plate. The effective numerical method of flux-splitting with Roe's scheme has been adopted in the present work. The results are all compared with experimental data. Dissert. Abstr.

N90-17049# National Inst. of Standards and Technology, Boulder, CO. Chemical Engineering Science Div.
OPTIMUM LOCATION OF FLOW CONDITIONERS IN A 4-INCH ORIFICE METER
Susan E. McFaddin, Charles F. Sindt, and James A. Brennan Jul. 1989 84 p
(Contract GRI-5088-271-1680)
(PB90-111675; NIST/TN-1330) Avail: NTIS HC A05/MF A01; SOD HC $4.25 as 003-003-02961-1 CSCL 20D

Two orifice flow measurement standards are presently used, one in the United States (ANSI/API 2530) and another in Europe (ISO 5167). These two standards have significantly different specifications for installations. One important specification is the location of the flow conditioner relative to the orifice plate. GRA

N90-17050*# California Univ., Berkeley. Lawrence Berkeley Lab.
DESIGN AND TESTING OF A SUPERFLUID LIQUID HELIUM COOLING LOOP
L. M. Gavin, M. A. Green, S. M. Levin, G. F. Smoot, and C. Witebsky Jul. 1989 8 p Presented at the International Cryogenic Materials Conference, Los Angeles, CA, 24-28 Jul. 1989
(Contract NAG5-1123; DE-AC03-76SF-00098)
(NASA-CR-182776; NAS 1.26:182776; DE90-002328; LBL-27826; CONF-890701-20) Avail: NTIS HC A02/MF A01 CSCL 20D

This paper describes the design and preliminary testing of a cryogenic cooling loop that uses a thermomechanical pump to circulate superfluid liquid helium. The cooling loop test apparatus is designed to prove forced liquid helium flow concepts that will be used on the Astromag superconducting magnet facility. DOE

N90-17051*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
LOW-NOISE NOZZLE VALVE Patent Application
Hal S. Gwin, inventor (to NASA) and James Aaron, inventor (to NASA) 7 Sep. 1989 15 p
(NASA-Case-MFS-28383-1; NAS 1.71:MFS-28383-1; US-Patent-Appl-SN-404290) Avail: NTIS HC A03/MF A01 CSCL 20D

A low noise, variable discharage area, valve is constructed having opposed recesses within which a pair of gates are slidably disposed. Each of the gates is provided with upstream edges having a radius thereon, the radius enabling smooth, accelerated, low noise flow therebetween. The gates are further provided with tracks along each side, which in turn slide along splines set in the side walls of the valve. A threaded rod which rotates in a threaded insert in a rear wall of each of the gates, serves to move the gates within their respective recesses. NASA

N90-17052*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
COMPUTATIONAL FLUID DYNAMICS
[1989] 43 p Original contains color illustrations
(NASA-TM-102922; NAS 1.15:102922) Avail: NTIS HC A03/MF A01 CSCL 20D

An overview of computational fluid dynamics (CFD) activities at the Langley Research Center is given. The role of supercomputers in CFD research, algorithm development, multigrid approaches to computational fluid flows, aerodynamics computer programs, computational grid generation, turbulence research, and studies of rarefied gas flows are among the topics that are briefly surveyed. R.J.F.

N90-17053# Pacific Northwest Lab., Richland, WA.
ROTARY ABSORPTION HEAT PUMP SENSITIVITY ANALYSIS Final Report
Judith Ann Bamberger and F. R. Zaloudek Oct. 1989 75 p Prepared for Conserve Resources, Inc., Prescott, WA
(Contract DE-FG01-86CE-15256)
(DE90-002877; DOE/CE-15256/T2) Avail: NTIS HC A04/MF A01

Conserve Resources, Incorporated is currently developing an innovative, patented absorption heat pump. The heat pump uses rotation and thin film technology to enhance the absorption process and to provide a more efficient, compact system. The results are presented of a sensitivity analysis of the rotary absorption heat pump (RAHP) performance conducted to further the development of a 1-ton RAHP. DOE

N90-17054# AFU Research Enterprises, Rio Rancho, NM.
MEASUREMENTS OF HEAT-TRANSFER COEFFICIENTS IN THE INTERACTION REGIONS BETWEEN OBLIQUE SHOCK WAVES AND TURBULENT BOUNDARY LAYERS WITH A MULTI-LAYERED THIN FILM HEAT TRANSFER GAUGE
Masanori Hayashi, Akira Sakaurai, and Shigeru Aso Sep. 1989 14 p Transl. into ENGLISH of unidentified Japanese document
(Contract DE-AC04-76DP-00789)
(DE90-004123; ALS/TR-89-25) Avail: NTIS HC A03/MF A01

A supersonic wind tunnel with a long air flow duration was used for the purpose of measuring in detail surface heat flux in the interference regions of the shock wave and the turbulence boundary layer. Moreover, a new heat flux sensor was tested and produced having high spatial resolution and high speed reaction properties, and reported in regard to its measurement principles, manufacturing method, and calibration methods. As for this sensor, an extremely thin film having a high resistance is formed on a thermally conductive body, and by obtaining the temperature slope which is created due to the heat flux which passes over this by means of a two layer metallic thin film resistive thermometer which is painted on the upper and lower surface of this film, the thermal flux can be obtained directly. DOE

N90-17055*# McDonnell Aircraft Co., Saint Louis, MO.
HEAT PIPES FOR WING LEADING EDGES OF HYPERSONIC VEHICLES Final Report
B. L. Boman, K. M. Citrin, E. C. Garner, and J. E. Stone Jan. 1990 122 p

(Contract NAS1-18144)
(NASA-CR-181922; NAS 1.26:181922) Avail: NTIS HC A06/MF A01 CSCL 20D

Wing leading edge heat pipes were conceptually designed for three types of vehicle: an entry research vehicle, aero-space plane, and advanced shuttle. A full scale, internally instrumented sodium/Hastelloy X heat pipe was successfully designed and fabricated for the advanced shuttle application. The 69.4 inch long heat pipe reduces peak leading edge temperatures from 3500 F to 1800 F. It is internally instrumented with thermocouples and pressure transducers to measure sodium vapor qualities. Large thermal gradients and consequently large thermal stresses, which have the potential of limiting heat pipe life, were predicted to occur during startup. A test stand and test plan were developed for subsequent testing of this heat pipe. Heat pipe manufacturing technology was advanced during this program, including the development of an innovative technique for wick installation.

Author

N90-17056*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
UPPER SEMICONTINUOUS GLOBAL ATTRACTORS FOR VISCOUS FLOW Final Report
Yuh-Roung Ou and S. S. Sritharan (University of Southern California, Los Angeles.) Jan. 1990 29 p Submitted for publication
(Contracts NAS1-18605; N00014-86-K-0679; AF-AFOSR-0079-89)
(NASA-CR-181976; NAS 1.26:181976; ICASE-90-2) Avail: NTIS HC A03/MF A01 CSCL 20D

A particular form of regularization of the Navier-Stokes equations is studied. It is shown that as the regularized parameter goes to zero, the global attractor for the regularized system converges to the global attractor for the conventional Navier-Stokes system.

Author

N90-17057# Kentucky Univ., Lexington. Dept. of Mechanical Engineering.
CAPILLARY FLOW PROPERTIES OF MESH WICKS Interim Report, Jul. 1987 - Aug. 1988
Jay H. Amborse and Louis C. Chow Jul. 1989 43 p
(Contract F33615-87-C-2777; AF Proj. 0812)
(AD-A214769; UK-ME-88-08; WRDC-TR-89-2083) Avail: NTIS HC A03/MF A01 CSCL 20/4

Prediction of heat pipe behavior is extremely important in the design of thermal control for all types of spacecraft. Heat pipes are an important element in spacecraft thermal control. Heat pipes may be subjected to pulsed-heat loading or rapid transients. Previous work in this area has pointed out the need for detailed modeling of the liquid flow in the wick. The amount of liquid in any portion of the wick depends not only on the instantaneous heat input and rejection, but on the loading history. Development of a detailed liquid flow model depends upon knowledge of the saturation dependence of the flow properties, because the detailed flow model accounts for the variation in the saturation in the wick with position and time. This report describes a research effort to determine the saturation dependence of the flow properties in a heat pipe wick. The report is divided into three sections covering the x ray saturation measurement system, the measurement of capillary pressure and the measurement of relative permeability. The objective of the present investigation is to measure the saturation dependence of the capillary flow properties for multilayer, square mech screen wicks. X ray radiography is used to measure the saturation in the wicks. Results are presented for the capillary pressure and saturation relationship from steady-state tests.

GRA

N90-17058# Maryland Univ. Baltimore County, Catonsville. Dept. of Mathematics and Statistics.
NONLINEAR HEAT TRANSFER AND WAVE MOTION Final Report, 1 Feb. 1987 - 31 Aug. 1989
James M. Greenberg Aug. 1989 3 p
(Grant AF-AFOSR-0112-87)
(AD-A214911; AFOSR-89-1487TR) Avail: NTIS HC A01/MF A01 CSCL 20/13

This research focused on properties of discrete Velocity Models on the Boltzmann equation. For transport processes topics of papers already completed under this grant include: Continuum Limits of discrete gases; Hyperbolic Heat Transfer Problems with Phase Transitions, in Nonlinear Hyperbolic Equations - Theory, Computations Methods, and Applications; Surging Glacial flows; Decay Theorems for the Broadwell Equations; and Collisionless Solutions to the Broadwell Equations. GRA

N90-17059# Massachusetts Inst. of Tech., Cambridge. Acoustics and Vibration Lab.
VELOCITY PROFILE AND WALL SHEAR STRESS MEASUREMENTS FOR A LARGE EDDY BREAK-UP (LEBU) DEVICE
Kurt W. Roth and Patrick Leehey 2 Nov. 1989 60 p Sponsored in part by David Taylor Research Center
(Contract N00014-89-J-1176)
(AD-A214958; A/V-71435-1) Avail: NTIS HC A04/MF A01 CSCL 20/3

Wind tunnel experiments were performed in the M.I.T. Acoustics and Vibrations Laboratory to determine the reduction in mean wall shear stress achieved by honeycomb matrix Large Eddy Break-Up Device (LEBU) and study how such a device alters a turbulent boundary layer. The LEBUs considered significantly altered the steady and unsteady velocity components, and moved the active region of the boundary layer further from the wall. The LEBUs studied achieved at least a 10 percent reduction of mean wall shear stress for distances over 300 displacement thicknesses behind the device. The LEBU parameter of height was found to affect the level and duration of mean wall shear stress reduction. Surface fence measurements indicated that the boundary layer manipulated by the LEBU does not adhere to the Coles Law of the Wall, possessing a large B intercept. GRA

N90-17060# Stanford Univ., CA.
ADVANCED DIAGNOSTICS FOR REACTING FLOWS Annual Report, 1 Oct. 1988 - 30 Sep. 1989
R. K. Hanson 12 Oct. 1989 35 p
(Grant AF-AFOSR-0067-89; AF Proj. 2308)
(AD-A215050; AFOSR-89-1433TR) Avail: NTIS HC A03/MF A01 CSCL 20/4

Progress is reported for an interdisciplinary program aimed at establishing advanced optical diagnostic techniques applicable to combustion and plasma flows. The primary effort is on digital flowfield imaging techniques, which offer significant potential for a wide range of spatially resolved 2-D and 3-D measurements. The imaging is accomplished by recording light scattered from a planar laser-illuminated region using a modern solid-state camera. The scattering process is generally laser-induced fluorescence, though Mie, Rayleigh and Raman scattering may also be used. Activities reported include: (1) image processing of PLIF data; (2) PLIF imaging in nonequilibrium shock tube flows; (3) temperature and velocity imaging in supersonic flows; (4) concept for simultaneous measurement of multiple parameters; (5) digital camera for high speed imaging; (6) plasma diagnostics; (7) laser photolysis shock tube; and (8) CW UV laser absorption diagnostics. GRA

N90-17061# Department of the Navy, Washington, DC.
HOT AIR HEAT GUN Patent Application
Terry L. Poston, inventor (to Navy) 23 Oct. 1989 8 p
(AD-D014312; US-Patent-Appl-SN-425663) Avail: NTIS HC A02/MF A01 CSCL 13/9

The invention relates generally to the art of self-contained heating devices and in particular to portable heating devices employing chemical reaction to produce heat. Currently, hand-held heat sources, capable of producing heat at a sufficiently high temperature to activate heat-shrink material, rely on either the combustion of flammable material or electrical power to provide energy for generating the required heat. An object of the present invention is to provide a portable device capable of providing sufficient heat to shrink heat-shrinkable tubing. A further object of

the invention is to provide a non-flammable heat source suitable for use in the presence of explosive atmospheres. Still another object of the invention is to provide a portable hand-held device for generating heat which can be directed to a specific location on a work surface. GRA

N90-17062# Massachusetts Univ., Amherst. Dept. of Mathematics and Statistics.
VORTEX CORES AND VORTEX BREAKDOWN Final Report, 1 Mar. 1987 - 31 Aug. 1989
Melvyn S. Berger 31 Aug. 1989 5 p
(Grant AF-AFOSR-0170-87; AF Proj. 2304)
(AD-A215266; AFOSR-89-1587TR) Avail: NTIS HC A01/MF A01 CSCL 20/4

A number of fundamental discoveries were made concerning vortex cores and vortex breakdown. Bifurcation processes of a mathematical nature are fundamental in understanding the two kinds of vortex breakdown (of bubble type and of spiral type). Additional mathematical procedure were used for the calculus of variations, to analysis axisymmetric vortex motion with swirl and helical vortex motion. The work on helical motion is described, and the work on axisymmetric vortices with swirl is given in preliminary form. GRA

N90-17063# Naval Postgraduate School, Monterey, CA.
EFFECT OF VORTEX CIRCULATION ON INJECTANT FROM A SINGLE FILM-COOLING HOLE AND A ROW OF FILM-COOLING HOLES IN A TURBULENT BOUNDARY LAYER. PART 1: INJECTION BENEATH THE VORTEX DOWNWASH M.S. Thesis
Douglas W. Craig Jun. 1989 314 p
(Contract MIPR-FY1455-88-N0608)
(AD-A215288) Avail: NTIS HC A14/MF A01 CSCL 20/4

The effects of longitudinal vortices on film-cooling injectant from a single injection hole and from a row of injection holes in a turbulent boundary layer are investigated. Attention is focussed on the effects of vortex circulation when the injection hole is located beneath the vortex downwash. Heat transfer measurements, mean velocity and mean temperature surveys, and surface flow visualization results are discussed. The embedded vortex considerably disturbs the injectant when Gamma U sub c (d) is greater than 1.0 where Gamma is the vortex circulation, U sub c is the injectant mean velocity and d is the injection hole diameter. GRA

N90-17064# Purdue Univ., West Lafayette, IN. School of Mechanical Engineering.
INFLUENCE OF WALL STRAIN RATE, POLYMER CONCENTRATION, AND CHANNEL HEIGHT UPON DRAG REDUCTION AND TURBULENT STRUCTURE Technical Report, 1 Dec. 1980 - 30 Nov. 1989
Kenneth J. Harder and William G. Tiederman Nov. 1989 129 p
(Contract N00014-83-K-0183)
(AD-A215378; PME-FM-89-1) Avail: NTIS HC A07/MF A01 CSCL 20/4

This study investigated fully developed, low polymer concentration, drag-reduced flows in two dimensional channels. Water flows at equal wall shear stress were also measured for comparison with the drag-reduced flows. The first objective of this study was to determine the dependence of drag reduction and turbulent structure upon wall strain rate, average polymer concentration and channel height. The second objective was to test a scale-up procedure for predicting drag reduction in one channel based on results in another channel. GRA

N90-17065# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
ANGLE OF ARRIVAL DETECTION THROUGH ANALYSIS OF OPTICAL FIBER INTENSITY PATTERNS M.S. Thesis
John Wallace Welker Dec. 1989 108 p
(AD-A215421; AFIT/GE/ENG/89D-57) Avail: NTIS HC A06/MF A01 CSCL 20/6

This thesis examined the feasibility of using optical fibers for angle of arrival (AOA) detection. Specifically, a uniform amplitude plane wave was transmitted through a 3 mm diameter, multimode, step-index, plastic fiber. Fiber lengths of 1 in., 2 in., and 3 in., were investigated. The output intensity pattern from each optical fiber was detected by a 512 x 512 resolution, charge injection device (CID) camera. The data array from the camera was preprocessed with a median filter, and normalized to the peak intensity. A fast Fourier transform converted the data to the frequency domain where the fundamental and first three harmonic frequencies were extracted. These 49 numbers represented components of a feature vector representing the pattern related to a specific AOA. Twenty-six template vectors, each representing a 1 deg increment from 0 deg to 25 deg, were created. Test vectors were compared to template vectors using Euclidean distance. The minimum distance classified the test vector AOA. GRA

N90-17066# Naval Ship Research and Development Center, Bethesda, MD.
APPENDAGE FLOW COMPUTATIONS USING THE INS3D COMPUTER CODE Final Report
Samuel Ohring Oct. 1989 105 p
(AD-A215689; DTRC-89/028) Avail: NTIS HC A06/MF A01 CSCL 20/4

The INS3D code, a steady state incompressible, fully 3-D Navier-Stokes solver, was applied to the computation of flow past an appendage mounted between two parallel flat plates of infinite extent at a Reynolds number of one-half million. The Baldwin-Lomax turbulence model was used to compute the eddy viscosity. The appendage consisted of a 1.5:1 elliptical nose and a NACA 0020 tail joined at maximum thickness of 0.24 chordlengths. A detailed description of the flow results covers all the major features of appendage flow and the results, for an unfilleted appendage, are in general agreement with experimental and other numerical results, except that the lateral location of the horseshoe vortex is larger than that in the experimental results. A detailed description is presented of the important trailing edge vortex. Detailed results for a second flow case, in which filleting is applied maiply to the front and side of the aforementioned appendage, show a greatly weakened horseshoe vortex but a still significant trailing edge vortex, that prevented velocity-deficit reduction in the wake, compared to the unfilleted appendage flow case. The calculations for the filleted case also exhibited an upstream instability. The plotting program PLOT3D was used to obtain color photos for flow visualization. GRA

N90-17067# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction de la Physique Generale.
STUDY OF PRESSURE SENSORS IN HYDRODYNAMIC TURBULENT BOUNDARY LAYER Final Report [ETUDE DE CAPTEURS DE PRESSION SOUS COUCHE LIMITE TURBULENTE HYDRODYNAMIQUE]
Francois Liousse (Centre d'Etudes et de Recherches, Toulouse, France) Aug. 1989 54 p In FRENCH
(Contract DRET-87-001-47)
(ONERA-RF-17/7218-PY; RF-1/2309-00/MES/CERT; ETN-90-96082) Avail: NTIS HC A04/MF A01

The procedure developed to evaluate the spatial weighting factors of wall pressure sensors are described. Starting from a small sensor, taken as a reference, it is possible to evaluate the weighting functions and to correct the measured spectral densities in order to obtain the real spectral densities of pressure variations. The validity of the method is limited by the maximum velocity and flow of the experimental set-up. ESA

N90-17068# Institut Franco-Allemand de Recherches, Saint-Louis (France).
DEVELOPMENT OF INTERFEROMETRIC AND HOLOGRAPHIC TECHNIQUES IN FLUID MECHANICS [DEVELOPPEMENT DES TECHNIQUES INTERFEROMETRIQUES ET HOLOGRAPHIQUES EN MECANIQUE DES FLUIDES]
P. Smigielski 16 Sep. 1988 38 p In FRENCH; ENGLISH

summary Presented at MESUCORA 88 Conference, Paris, France, 14 Nov. 1988
(ISL-CO-227/88; ETN-90-96089) Avail: NTIS HC A03/MF A01

The optical methods used to make images of fluid flow are reviewed. The exploitation of holographic techniques to visualize flow is also discussed. The visualization of a section of the flow using the laser plane technique, and the determination of the instantaneous velocity fields by speckle interferometry is explained. Photographs illustrating the various methods are included. ESA

N90-17069# Institut Franco-Allemand de Recherches, Saint-Louis (France).
THEORETICAL AND EXPERIMENTAL APPROACH OF WAVE PHENOMENA IN FREE JETS [APPROCHE THEORIQUE ET EXPERIMENTALE DES PHENOMENES ONDULATOIRES DANS LES JETS LIBRES]
J. Haertig 30 Nov. 1988 18 p In FRENCH Presented at the 25th Colloque d'Aerodynamique Appliquee, Talence, France, 12-14 Oct. 1988
(ISL-CO-247/88; ETN-90-96095) Avail: NTIS HC A03/MF A01

The Rayleigh equation is used to study various perturbation types. In low compressibility jets, analytical methods are used to predict the behavior of instability waves which are identified as the large structures observed in flow visualization. The nonlinear space evolution of the instability waves is studied. The results are compared to laser Doppler anemometer results. Good agreement is found. ESA

N90-17070# Institut Franco-Allemand de Recherches, Saint-Louis (France).
FORMATION OF A PAIR OF TURBULENT LAYERS IN THE REGION OF A FLOW AROUND AN AXISYMMETRIC BODY WITH AN INCIDENCE ANGLE [FORMATION D'UNE PAIRE DE NAPPES TOURBILLONNAIRES DANS LA ZONE DECOLLEE DE L'ECOULEMENT AUTOUR D'UN CORPS ELANCE DE REVOLUTION EN INCIDENCE]
J.-L. Besse 31 Dec. 1987 75 p In FRENCH
(ISL-R-130/87; ETN-90-96097) Avail: NTIS HC A04/MF A01

A computational method is developed to evaluate the evolution of the turbulent layers formed around aircraft bodies at large incidence. As a first approximation a two dimensional unsteady flow around a cylinder is calculated. The model includes a potential flow with multiple vortices. The axial evolution of this flow allows the building of a three dimensional approximation. The planned visualization experiments are discussed. ESA

N90-17071# Institut Franco-Allemand de Recherches, Saint-Louis (France).
FORMATION OF TURBULENT LAYERS IN THE SEPARATED REGION AROUND A BODY WITH POLYGONAL CROSS SECTION AT LARGE INCIDENCE AND ROLLING [FORMATION DE NAPPES TOURBILLONNAIRES DANS LA ZONE DECOLLEE DE L'ECOULEMENT AUTOUR D'UN CORPS ELANCE DE SECTION POLYGONALE EN INCIDENCE ET EN ROULIS]
J.-L. Besse 22 Jan. 1988 108 p In FRENCH
(ISL-R-101/88; ETN-90-96098) Avail: NTIS HC A06/MF A01

A computational procedure is developed to evaluate the evolution of the turbulent layers originated in ridges of polygonal cross section bodies which are placed in incidence and rolling in a flow, and to determine the effects of these phenomena on the aerodynamical efforts. The case is applicable to cruising missiles with nonconventional geometry. Comparison with the few available results shows the validity of the method. ESA

N90-17072# Ecole Normale Superieure, Paris (France).
STUDY FOR THE DISSIPATIVE STRUCTURES GEOMETRY IN THREE DIMENSIONAL DEVELOPED TURBULENCE Final Report [ETUDE DE LA GEOMETRIE DES STRUCTURES DISSIPATIVES DE LA TURBULENCE DEVELOPPEE TRIDIMENSIONNELLE]
Marc E. Brachet Mar. 1989 46 p In FRENCH
(Contract DRET-87-1483)
(ETN-90-96102) Avail: NTIS HC A03/MF A01

A Taylor-Green vortex study is carried out, increasing the definition from 256 to 864 points, for each of the three dimensions. The study is carried out on a Cray 2 machine. The code developed for the study is discussed. The results show that the choice of algorithms, multitasking and vectorization yield a very efficient code. The first visualizations on SUN stations are encouraging. ESA

N90-17073# Ecole Normale Superieure, Paris (France). Lab. de Meteorologie Dynamique.
THEORETICAL STUDY OF INSTABILITIES IN VORTICES: APPLICATIONS TO HYDRODYNAMICS AND MAGNETOHYDRODYNAMICS Final Report [ETUDE THEORIQUE DES INSTABILITES DANS LES VORTEX: APPLICATIONS A L'HYDRODYNAMIQUE ET A LA MAGNETOHYDRODYNAMIQUE]
J. Chaskalovic 1988 7 p In FRENCH
(Contract DRET-87-1409/DS/SR)
(ETN-90-96103) Avail: NTIS HC A02/MF A01

The work is a continuation of Serrin (1972), changing the linear perturbation method by a functional analysis method, after obtaining the velocity fields as fixed points of a defined operator in a well chosen space. The main result is to establish that at low Reynolds number the solution is stable for small perturbations. The unsteady problem of tornado formation is studied with the same method, but it is found that the method leads to steady solutions only. ESA

N90-17074*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
OPTIMUM ELEMENT DENSITY STUDIES FOR FINITE-ELEMENT THERMAL ANALYSIS OF HYPERSONIC AIRCRAFT STRUCTURES
William L. Ko, Timothy Olona, and Kyle M. Muramoto Jan. 1990 36 p
(NASA-TM-4163; H-1519; NAS 1.15:4163) Avail: NTIS HC A03/MF A01 CSCL 20D

Different finite element models previously set up for thermal analysis of the space shuttle orbiter structure are discussed and their shortcomings identified. Element density criteria are established for the finite element thermal modelings of space shuttle orbiter-type large, hypersonic aircraft structures. These criteria are based on rigorous studies on solution accuracies using different finite element models having different element densities set up for one cell of the orbiter wing. Also, a method for optimization of the transient thermal analysis computer central processing unit (CPU) time is discussed. Based on the newly established element density criteria, the orbiter wing midspan segment was modeled for the examination of thermal analysis solution accuracies and the extent of computation CPU time requirements. The results showed that the distributions of the structural temperatures and the thermal stresses obtained from this wing segment model were satisfactory and the computation CPU time was at the acceptable level. The studies offered the hope that modeling the large, hypersonic aircraft structures using high-density elements for transient thermal analysis is possible if a CPU optimization technique was used. Author

N90-17075# Aeronautical Research Inst. of Sweden, Stockholm.
A SOLUTION METHOD FOR THE TIME-DEPENDENT NAVIER-STOKES EQUATIONS FOR LAMINAR, INCOMPRESSIBLE FLOW
Peter Eliasson 1989 45 p
(FFA-146) Avail: NTIS HC A03/MF A01

For the solution of the incompressible, time dependent Navier-Stokes equation, an explicit Adams-Bashforth, finite-volume solver was created. The solution method is based on a fractional step approach using the primitive variable formulation of the governing equations leading to a Poisson equation for the pressure to be solved at each time step. The finite-volume formulation uses the volume fluxes across the faces of each computational cell

and the pressure as dependent variables. A multigrid method is chosen to solve the Poisson equation for the pressure in order to reduce the computational time. A staggered, boundary-fitted mesh system is used for arbitrary geometries. The discretized equations are second order accurate in time and space. Numerical results are presented in two dimensions on a test case where the analytical solution is known and on a cylinder for laminar flow. The second order accuracy in space is proven for a Cartesian mesh. The numerical results for the cylinder were shown to be in good agreement with other numerical results and with experimental data. Author

N90-17076*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ON THE NUMERICAL SOLUTION OF THE DYNAMICALLY LOADED HYDRODYNAMIC LUBRICATION OF THE POINT CONTACT PROBLEM
Sang G. Lim, David E. Brewe, and Joseph M. Prahl (Case Western Reserve Univ., Cleveland, OH.) Feb. 1990 30 p Proposed for presentation at the Annual Meeting of the Society of Tribologists and Lubrication Engineers, Denver, CO, 7-11 May 1990 Prepared in cooperation with Army Aviation Research and Development Command, Cleveland, OH
(DA Proj. 1L1-61102-AH-45)
(NASA-TM-102427; E-5193; NAS 1.15:102427; AVSCOM-TR-89-C-021) Avail: NTIS HC A03/MF A01 CSCL 20D

The transient analysis of hydrodynamic lubrication of a point-contact is presented. A body-fitted coordinate system is introduced to transform the physical domain to a rectangular computational domain, enabling the use of the Newton-Raphson method for determining pressures and locating the cavitation boundary, where the Reynolds boundary condition is specified. In order to obtain the transient solution, an explicit Euler method is used to effect a time march. The transient dynamic load is a sinusoidal function of time with frequency, fractional loading, and mean load as parameters. Results include the variation of the minimum film thickness and phase-lag with time as functions of excitation frequency. The results are compared with the analytic solution to the transient step bearing problem with the same dynamic loading function. The similarities of the results suggest an approximate model of the point contact minimum film thickness solution. Author

N90-17077 ESDU International Ltd., London (England).
PRESSURE LOSSES IN FLOW THROUGH A SUDDEN CONTRACTION OF DUCT AREA Abstract Only
Dec. 1989 38 p Supersedes ESDU-78007
(ESDU-89040; ISBN-0-85679-713-8; ISSN-0141-4011; ESDU-78007) Avail: ESDU

ESDU 89040 provides a semi-empirical method for predicting the static- and total-pressure losses through, and the exit Mach number from, an axi-symmetric sudden contraction of area in a single-phase flow. The edges of the smaller pipe at the contraction plane may be sharp or radiused (with the ratio of the corner radius to the smaller diameter up to 0.2). The method applies to incompressible flow (for liquids) or compressible flow (for gases); in the latter case a graphical method is given for the ratio of specific heat capacities of 1.4, but a FORTRAN program listing is also given to deal with any other value of the ratio of specific heat capacities. The region of the experimental data available in the literature is indicated, but considerable extrapolation has been used, guided by theoretical methods. Worked examples illustrate the use of the methods and indicate the format of the input to and output from the program. ESDU

N90-17078 ESDU International Ltd., London (England).
BOILING INSIDE TUBES: PRESSURE DROP IN STRAITHT TUBES WITH UPWARD OR HORIZONTAL FLOW Abstract Only
Nov. 1989 39 p
(ESDU-89039; ISBN-0-85679-712-X; ISSN-0141-402X) Avail: ESDU

ESDU 89039 provides a method for predicting pressure drop based on an empirical correction applied to the adiabatic pressure drop which is calculated in three components: the friction component following the method due to Friedel, the gravity component for which the Premoli et al., correlation is used, and the momentum component using homogeneous theory. The empirical factor is derived from a correlation of experimental data drawn from the literature, mainly for water but also for a number of refrigerants, hydrogen and pentane. A table gives the scope of the experimental results together with their sources, and there are over 5000 points for vertical tubes and over 2500 for horizontal tubes. Tables present, as a function of the boiling number, the ratio of the liquid to vapor density and the quality, the number of data points available, their mean error from the predicted values, and their standard deviation. In addition, sketches compare the predicted values with the experimental in plots against Weber number. A detailed step-by-step calculation procedure is set out, and is illustrated with a worked example. Some guidance is given for dealing with tubes at other orientations and for estimating the pressure drop at inlet to and outlet from the tube and in 180 degree bends that interconnect the horizontal lengths of serpentine coils. ESDU

N90-17079# Oak Ridge National Lab., TN.
ASSESSMENT OF GROUND-COUPLED HEAT PUMPS Foreign Trip Report
V. C. Mei 5 Dec. 1989 4 p
(Contract DE-AC05-84OR-21400)
(DE90-003977; ORNL/FTR-3492) Avail: NTIS HC A01/MF A01

The objectives of the third working meeting were to assess the accomplishments to date in direct-expansion ground-coupled heat exchanger study and to discuss what should be done in the future. DOE

N90-17080# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
ASSESSMENT OF STRENGTH LIMITING FLAWS IN CERAMIC HEAT EXCHANGER TUBES, PHASE 2
W. G. Reuter, W. R. Lloyd, J. R. Knibloe, and E. Storhok Oct. 1989 65 p
(Contract DE-AC07-76ID-01570)
(DE90-004081; DOE/ID-10249) Avail: NTIS HC A06/MF A01

A model, based on fracture mechanics concepts, for predicting a minimum operating lifetime for ceramic heat exchanger tubes is described. The tubes were fabricated from siliconized silicon carbide. The model uses data generated for this specific material operating in an air environment at 1250 C to illustrate the concept. Critical information needed in order to use the model is identified. Plane strain fracture toughness (K sub Ic), environmental effects (static fatigue and K sub Ic), and verification test data are provided. DOE

N90-17081# Pacific Northwest Lab., Richland, WA.
NUMERICAL PREDICTIONS OF LOCAL ENTROPY GENERATION FOR AN IMPINGING JET
M. D. White and M. K. Drost Apr. 1989 24 p Presented at the ASME Winter Annual Meeting, San Francisco, CA, 10-15 Dec. 1989
(Contract DE-AC06-76RL-01830)
(DE90-004671; PNL-SA-16718; CONF-891208-28) Avail: NTIS HC A03/MF A01

Predictions of local volumetric entropy generation rates were made numerically for the convective heat transfer problems of a fluid jet impinging on isothermal and constant heat flux surfaces. The solution technique yielded a scalar field of volumetric entropy generation rates that extends over the fluid domain. For isotropic and Newtonian fluids local entropy generation rates, that stem from the irreversible phenomena of heat transfer across a finite temperature difference and viscous fluid flow, may be computed from fields of temperature, local temperature gradients, and the local viscous dissipation function. The primary points of interest for this problem were to investigate the surface heat transfer rates

as a function of inlet jet velocities, and the apportionment between viscous and thermal source entropy generation. The problem investigated was restricted to two-dimensional slot jet flow with two fluids, helium and glycerin. DOE

N90-17082# Washington Univ., Seattle. Dept. of Applied Mathematics.
THE EVOLUTION OF LINEARIZED PERTURBATIONS OF PARALLEL FLOWS
W. O. Criminale and P. G. Drazin Nov. 1989 48 p
(Contract DE-FG06-88ER-25061)
(DE90-005978; DOE/ER-25061/3; TR-89-6) Avail: NTIS HC A03/MF A01

The equations of an incompressible fluid are linearized for small perturbations of a basic parallel flow. The initial-value problem is then posed by use of Fourier transforms in space. Previous results are systematized in a general framework and used to solve a series of problems for prototypical examples of basic shear and of initial disturbance. The prototypes of shear flow are plane Couette flow bounded by rigid parallel walls, plane Couette flow bounded by rigid walls at constant pressure, unbounded two-layer flow with linear velocity profile in each layer, a piecewise linear profile of a boundary layer on a rigid wall. The prototypes of initial perturbation are the fundamental ones: point source of the field of the transverse velocity (represented by delta functions), an unbounded sinusoidal field of the transverse velocity, a point source of the lateral component of vorticity, and a sinusoidal field of the lateral vorticity. Detailed solutions for an inviscid fluid are presented, but the problem for a viscous fluid is only broached. DOE

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing*. For related information see also *06 Aircraft Instrumentation*, and *19 Spacecraft Instrumentation*.

N90-17083 Ohio State Univ., Columbus.
POWER SYSTEM MODELING FOR A SIX LEGGED WALKING VEHICLE Ph.D. Thesis
Satishkumar S. Nair 1988 222 p
Avail: Univ. Microfilms Order No. DA8907273

Power system of a legged vehicle is considerably more complex than the one used by a conventional land vehicle because of the wide range of power demands and the large number of degrees of freedom required for coordination and stability. Very little is currently known about the generalized power and actuation requirements for such vehicles. This dissertation undertakes a study of the conceptual and physical characteristics of the power system of a typical rough terrain six legged vehicle. Detailed analytical and digital simulation models have been developed for the power system consisting of the prime mover, energy storage system, mechanical drives, hydraulic actuation systems and the control systems. Modeling techniques and design concepts pertaining to such systems have been developed and the complex interactions between the mechanical, hydraulic and computer systems have been studied. These models and concepts can easily be extended to similar vehicles and robotic systems. Theoretical basis for studies of the dynamic and control issues for the legs has been established. A new model for the low frequency dynamics of the servovalve has been proposed using the describing function approach which explains the small signal limit cycle behavior of the actuation system successfully. Models for the mechanical transmission have been used successfully to modify system parameters and to eliminate potentially troublesome torsional vibrations. Dissert. Abstr.

N90-17084 California Univ., Los Angeles.
FORMULATION AND VERIFICATION OF A TECHNIQUE FOR COMPENSATION OF PNEUMATIC ATTENUATION ERRORS IN AIRBORNE PRESSURE SENSING DEVICES Ph.D. Thesis
Stephen Anthony Whitmore 1989 203 p
Avail: Univ. Microfilms Order No. DA8922215

Recent advances in aircraft performance and maneuver capablilty have dramatically complicated the problem of flight control augmentation. With increasing regularity, aircraft system designs require that aerodynamic parameters derived from pneumatic measurements be used as control system feedbacks. These requirements necessitate that pneumatic data be measured with accuracy and fidelity. The emphasis here is on the development of a general numerical model for accurately predicting pneumatic attenuation errors in pressure sensing devices. Once the model was developed and verified, then techniques for inverting the model to provide a compensation algorithm were developed. A mathematical model, derived from the Navier-Strokes equations is used to predict the behavior of pneumatic configurations which are subjected to small but arbitrary inputs. Comparisons of the mathematical model to both lab and flight data indicate that its predictive capability is excellent. Two approaches for inverting the model to provide a compensation algorithm were developed. The first approach relied on the techniques of statistical deconvolution to develop a compensation model. The second technique overcame the difficulty of limited applicability inherent in the first approach by incorporating the dynamic model into the compensation routine using the techniques of Minimum Variance Estimation Theory. The latter algorithm has a broader range of applicability.
Dissert. Abstr.

N90-17085*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
NASA LASER LIGHT SCATTERING ADVANCED TECHNOLOGY DEVELOPMENT WORKSHOP, 1988
William V. Meyer, ed. (Case Western Reserve Univ., Cleveland, OH.) Aug. 1989 306 p Workshop held in Cleveland, OH, 7-8 Sep. 1988
(NASA-CP-10033; E-4915; NAS 1.55:10033) Avail: NTIS HC A14/MF A02 CSCL 14B

The major objective of the workshop was to explore the capabilities of existing and prospective laser light scattering hardware and to assess user requirements and needs for a laser light scattering instrument in a reduced gravity environment. The workshop addressed experimental needs and stressed hardware development. For individual titles, see N90-17086 through N90-17102.

N90-17086*# Kiel Univ. (Germany, F.R.).
LASER LIGHT SCATTERING REVIEW **c36**
Klaus Schaetzel *In* NASA, Lewis Research Center, NASA Laser Light Scattering Advanced Technology Development Workshop, 1988 Aug. 1989 p 1-23 (For primary document see N90-17085 09-35)
Avail: NTIS HC A14/MF A02 CSCL 20E

Since the development of laser light sources and fast digital electronics for signal processing, the classical discipline of light scattering on liquid systems experienced a strong revival plus an enormous expansion, mainly due to new dynamic light scattering techniques. While a large number of liquid systems can be investigated, ranging from pure liquids to multicomponent microemulsions, this review is largely restricted to applications on Brownian particles, typically in the submicron range. Static light scattering, the careful recording of the angular dependence of scattered light, is a valuable tool for the analysis of particle size and shape, or of their spatial ordering due to mutual interactions. Dynamic techniques, most notably photon correlation spectroscopy, give direct access to particle motion. This may be Brownian motion, which allows the determination of particle size, or some collective motion, e.g., electrophoresis, which yields particle mobility data. Suitable optical systems as well as the necessary data processing schemes are presented in some detail. Special attention is devoted

to topics of current interest, like correlation over very large lag time ranges or multiple scattering. Author

N90-17087*# Maryland Univ., College Park. Inst. for Physical Science and Technology.
CRITICAL FLUID LIGHT SCATTERING c74
Robert W. Gammon *In* NASA, Lewis Research Center, NASA Laser Light Scattering Advanced Technology Development Workshop, 1988 Aug. 1989 p 25-44 Previously announced in IAA as A88-33009 (For primary document see N90-17085 09-35)
(Grant NAG3-727)
Avail: NTIS HC A14/MF A02 CSCL 20A

Thermal fluctuations give rise to a host of thermodynamic anomalies near critical points. The background for these phenomena is presented, and an experimental design on STS flight experiment called Zeno is described. The objective is to measure the decay rates of critical density fluctuations in a simple fluid (xenon) very near its liquid-vapor critical point using laser light scattering and photon correlation spectroscopy. Such experiments have been limited on Earth by the presence of gravity, which causes large density gradients in the sample. Fluctuation decay rates in xenon will be measured at least 100 times closer to the critical point than is possible on Earth. This will require taking data as close as 145 micro K to the critical temperature, after locating it to + or - 10 micro K. The minimum mission time of 100 hours will allow a complete range of temperature points to be covered, limited by the thermal response of the sample. An essential part of the apparatus is the thermostat. Its design principles and key features are given together with some observed performance characteristics of a prototype: + or - 20 micro K stability for 18 hours, and one minute programmed step response for steps less than 10 mK. Author

N90-17088*# Royal Signals and Radar Establishment, Malvern (England).
MINIATURE INSTRUMENTATION FOR LASER LIGHT SCATTERING EXPERIMENTS
Robert G. W. Brown *In* NASA, Lewis Research Center, NASA Laser Light Scattering Advanced Technology Development Workshop, 1988 Aug. 1989 p 45-63 (For primary document see N90-17085 09-35)
Avail: NTIS HC A14/MF A02 CSCL 14B

Traditional optical systems for photon correlation spectroscopy and laser anemometry have relied upon physically large and fairly expensive lasers, bulk-optics such as lenses of a few inches diameter, large mechanical mounts and carefully selected, fragile and bulky photon counting photomultiplier detectors. In some cases, experimental fluid dynamics at a desired position in a flow, perhaps deep inside complex machinery, is physically impossible or very difficult. Similar problems exist with photon correlation spectroscopy, e.g., remote and heterodyne experiments. Various optical and electro optical components were investigated and characterized with the aim of replacing existing photon correlation laser spectroscopy and anemometry techniques in miniaturized form, and with significant cost reduction. Very recently, a range of miniature, modular light scattering systems were constructed from little solid state optical and electro optical components, and experimentally verified measurement performance comparable to standard lab photon correlation spectroscopy and laser anemometry equipment. Author

N90-17089*# RCA Ltd., Vaudreuil (Quebec). Electro-Optics Dept.
PHOTON COUNTING MODULES USING RCA SILICON AVALANCHE PHOTODIODES
Alexander W. Lightstone, Andrew D. MacGregor, Darlene E. MacSween, Robert J. McIntyre, Claude Trottier, and Paul P. Webb *In* NASA, Lewis Research Center, NASA Laser Light Scattering Advanced Technology Development Workshop, 1988 Aug. 1989 p 65-80 (For primary document see N90-17085 09-35)
Avail: NTIS HC A14/MF A02 CSCL 14B

Avalanche photodiodes (APD) are excellent small area, solid state detectors for photon counting. Performance possibilities include: photon detection efficiency in excess of 50 percent; wavelength response from 400 to 1000 nm; count rate to 10 (exp 7) counts per sec; afterpulsing at negligible levels; timing resolution better than 1 ns. Unfortunately, these performance levels are not simultaneously available in a single detector amplifier configuration. By considering theoretical performance predictions and previous and new measurements of APD performance, the anticipated performance of a range of proposed APD-based photon counting modules is derived. Author

N90-17090*# State Univ. of New York, Stony Brook. Dept. of Electrical Engineering.
DESIGN OF FIBER OPTIC PROBES FOR LASER LIGHT SCATTERING c74
Harbans S. Dhadwal and Benjamin Chu *In* NASA, Lewis Research Center, NASA Laser Light Scattering Advanced Technology Development Workshop, 1988 Aug. 1989 p 81-98 (For primary document see N90-17085 09-35)
Avail: NTIS HC A14/MF A02 CSCL 20A

A quantitative analysis is presented of the role of optical fibers in laser light scattering. Design of a general fiber optic/microlens probe by means of ray tracing is described. Several different geometries employing an optical fiber of the type used in lightwave communications and a graded index microlens are considered. Experimental results using a nonimaging fiber optic detector probe show that due to geometrical limitations of single mode fibers, a probe using a multimode optical fiber has better performance, for both static and dynamic measurements of the scattered light intensity, compared with a probe using a single mode fiber. Fiber optic detector probes are shown to be more efficient at data collection when compared with conventional approaches to measurements of the scattered laser light. Integration of fiber optic detector probes into a fiber optic spectrometer offers considerable miniaturization of conventional light scattering spectrometers, which can be made arbitrarily small. In addition static and dynamic measurements of scattered light can be made within the scattering cell and consequently very close to the scattering center.
Author

N90-17091*# Case Western Reserve Univ., Cleveland, OH. Dept. of Chemical Engineering.
MAXIMUM LIKELIHOOD TECHNIQUES IN QELS c36
Robert V. Edwards *In* NASA, Lewis Research Center, NASA Laser Light Scattering Advanced Technology Development Workshop, 1988 Aug. 1989 p 99-118 (For primary document see N90-17085 09-35)
Avail: NTIS HC A14/MF A02 CSCL 20E

A framework for the analysis of Quasi Elastic Light Scattering (QELS) experiments designed to be used in microgravity environment is derived. Example calculations of the type to be used to design the QELS system are given. The framework for the analysis is based on the concepts of parameter estimation typified by Maximum Likelihood Estimation methods. These methods not only serve as the template for parameter estimation algorithms, but can also be used for optimal design of the experiments. Optimal design of experiments is facilitated by the fact that these methods not only give procedures for parameter estimation, but also estimates of the errors associated with the parameter estimation. Author

N90-17092*# Akron Univ., OH. Dept. of Chemical Engineering.
IMPROVED OPTICS FOR LASER LIGHT SCATTERING c36
H. Michael Cheung *In* NASA, Lewis Research Center, NASA Laser Light Scattering Advanced Technology Development Workshop, 1988 Aug. 1989 p 119-133 (For primary document see N90-17085 09-35)
Avail: NTIS HC A14/MF A02 CSCL 20E

Laser light scattering experiments contemplated for use in a microgravity environment must conform to a number of operational constraints which do not apply on Earth. In particular, the use of index matching fluid to control flare is unacceptable. Work to

eliminate index matching fluids by the use of high spatial resolution receiving optics is described. By increasing on-axis spatial resolution flare from the sample cell walls (both the cell sample and cell air interfaces) can be effectively prevented from reaching the photodetector. In general, improving the on-axis discrimination degrades the angular resolution of a receiving optical train. Several different possible configurations of receiving optics are compared for their spatial resolution and angular resolution. For cylinder symmetric optics, the dual lens, fourier transform pair, receiving train with a center mask located between the lenses gives the best on-axis spatial resolution. Author

N90-17093*# Brookhaven Instruments Corp., Holtsville, NY.
ADVANCED INSTRUMENTATION FOR QELS EXPERIMENTS **c74**
Walther Tscharnuter, Bruce Weiner, and John Thomas *In* NASA, Lewis Research Center, NASA Laser Light Scattering Advanced Technology Development Workshop, 1988 Aug. 1989 p 135-139 (For primary document see N90-17085 09-35)
Avail: NTIS HC A14/MF A02 CSCL 20A

Quasi Elastic Light Scattering (QELS) experiments have become an important tool in both research and quality control applications during the past 25 years. From the crude beginnings employing mechanically driven spectrum analyzers, an impressive array of general purpose digital correlators and special purpose particle sizers is now commercially available. The principles of QELS experiments are reviewed, their advantages and disadvantages are discussed and new instrumentation is described. Author

N90-17094*# Coulter Electronics, Inc., Amherst, MA. Langley Ford Instruments.
ENHANCED RESOLUTION PARTICLE SIZE DISTRIBUTIONS BY MULTIPLE ANGLE PHOTON CORRELATION SPECTROSCOPY **c74**
Steven E. Bott *In* NASA, Lewis Research Center, NASA Laser Light Scattering Advanced Technology Development Workshop, 1988 Aug. 1989 p 141-152 (For primary document see N90-17085 09-35)
Avail: NTIS HC A14/MF A02 CSCL 20A

Photon correlation spectroscopy (PCS) has become a method of choice for measuring submicrometer particles. It is capable of rapid, accurate measurements of mean particle size. Since the measurements are nonperturbing, it is ideal for monitoring systems undergoing dynamic changes. Despite its widespread acceptance, the information content of PCS measurements for particle size distributions is low and provides limited resolution. A method is presented whereby PCS measurements made at several scattering angles plus the angular distribution of light scattered from the particles are combined in a single simultaneous analysis to effect an enhanced resolution particle size distribution. The efficacy of the method is assessed by recovering size distributions from computer simulated data and by comparisons of conventional PCS measurements of polystyrene spheres with those made by the new method. Author

N90-17095*# Particle Sizing Systems, Inc., Santa Barbara, CA.
ONLINE SUBMICRON PARTICLE SIZING BY DYNAMIC LIGHT SCATTERING USING AUTODILUTION **c74**
David F. Nicoli and V. B. Elings *In* NASA, Lewis Research Center, NASA Laser Light Scattering Advanced Technology Development Workshop, 1988 Aug. 1989 p 153-164 (For primary document see N90-17085 09-35)
Avail: NTIS HC A14/MF A02 CSCL 20A

Efficient production of a wide range of commercial products based on submicron colloidal dispersions would benefit from instrumentation for online particle sizing, permitting real time monitoring and control of the particle size distribution. Recent advances in the technology of dynamic light scattering (DLS), especially improvements in algorithms for inversion of the intensity autocorrelation function, have made it ideally suited to the measurement of simple particle size distributions in the difficult submicron region. Crucial to the success of an online DSL based instrument is a simple mechanism for automatically sampling and diluting the starting concentrated sample suspension, yielding a final concentration which is optimal for the light scattering measurement. A proprietary method and apparatus was developed for performing this function, designed to be used with a DLS based particle sizing instrument. A PC/AT computer is used as a smart controller for the valves in the sampler diluter, as well as an input-output communicator, video display and data storage device. Quantitative results are presented for a latex suspension and an oil-in-water emulsion. Author

N90-17096*# Wyatt Technology Co., Santa Barbara, CA.
LIGHT SCATTERING INSTRUMENTATION FOR MICRO GRAVITY RESEARCH
Philip J. Wyatt *In* NASA, Lewis Research Center, NASA Laser Light Scattering Advanced Technology Development Workshop, 1988 Aug. 1989 p 165-172 (For primary document see N90-17085 09-35)
Avail: NTIS HC A14/MF A02 CSCL 14B

The analysis of light scattered from an ensemble of particles has long been a preferred method for characterizing their physical properties. Instrumentation to perform the measurements which forms the basis for such analysis is available in many forms based upon a variety of different experimental techniques. A system is presented which is singularly applicable for making many types of measurements in a microgravity environment. The commercial version of this device, the DAWN-F, has been used in many labs throughout the world to perform analyses of particular importance for both research and production. Light scattering theory is reviewed and the structure and function of the system is described. Author

N90-17097*# Exxon Research and Engineering Co., Annandale, NJ.
LASER LIGHT SCATTERING AS A PROBE OF FRACTAL COLLOID AGGREGATES **c36**
David A. Weitz and M. Y. Lin *In* NASA, Lewis Research Center, NASA Laser Light Scattering Advanced Technology Development Workshop, 1988 Aug. 1989 p 173-183 Prepared in cooperation with City Univ. of New York, NY (For primary document see N90-17085 09-35)
Avail: NTIS HC A14/MF A02 CSCL 20E

The extensive use of laser light scattering is reviewed, both static and dynamic, in the study of colloid aggregation. Static light scattering enables the study of the fractal structure of the aggregates, while dynamic light scattering enables the study of aggregation kinetics. In addition, both techniques can be combined to demonstrate the universality of the aggregation process. Colloidal aggregates are now well understood and therefore represent an excellent experimental system to use in the study of the physical properties of fractal objects. However, the ultimate size of fractal aggregates is fundamentally limited by gravitational acceleration which will destroy the fractal structure as the size of the aggregates increases. This represents a great opportunity for spaceborne experimentation, where the reduced g will enable the growth of fractal structures of sufficient size for many interesting studies of their physical properties. Author

N90-17098*# Ohio State Univ., Columbus. Dept. of Ceramic Engineering.
AGGLOMERATION OF CERAMIC POWDERS **c27**
James D. Cawley, Judith LaRosa, and Fredrick Dirkse *In* NASA, Lewis Research Center, NASA Laser Light Scattering Advanced Technology Development Workshop, 1988 Aug. 1989 p 185-197 (For primary document see N90-17085 09-35)
Avail: NTIS HC A14/MF A02 CSCL 11C

A research program directed at a critical comparison of numerical models for power agglomeration with experimental observations is currently underway. Central to this program is the quantitative characterization of the distribution of mass within an agglomerate as a function of time. Current experiments are designed to restrict agglomeration to a surface, which is oriented perpendicular to the force of gravity. These experiments are discussed with reference to: their significance to ceramic

processing; artifacts which may be avoided in microgravity experiments; and the comparison of information available in real space (from optical microscopy) to that in reciprocal space (from light scattering). The principle machine requirement appears to be a need to obtain information at small scattering angles. Author

N90-17099*# Rice Univ., Houston, TX. Dept. of Chemical Engineering.
THEORY OF MICROEMULSIONS IN A GRAVITATIONAL FIELD c25
J. F. Jeng and Clarence A. Miller *In* NASA, Lewis Research Center, NASA Laser Light Scattering Advanced Technology Development Workshop, 1988 Aug. 1989 p 199-214 (For primary document see N90-17085 09-35)
Avail: NTIS HC A14/MF A02 CSCL 07D

A theory of microemulsions developed previously is extended to include the effect of a gravitational field. It predicts variation with position of drop size, drop volume fraction, and area per molecule in the surfactant films within a microemulsion phase. Variation in volume fraction is greatest and occurs in such a way that oil content increases with increasing elevation, as has been found experimentally. Large composition variations are predicted within a middle phase microemulsion near optimal conditions because inversion from the water-continuous to the oil-continuous arrangement occurs with increasing elevation. Generally speaking, gravity reduces solubilization within microemulsions and promotes separation of excess phases. Author

N90-17100*# University of Southern Mississippi, Hattiesburg. Dept. of Polymer Science.
PROPOSED USES OF LASER LIGHT SCATTERING INSTRUMENTS FOR POLYMERIZATION STUDIES
Lon J. Mathias, Charles E. Hoyle, Kevin McLaughlin, Samuel P. McManus, James M. Caruthers, and Michael L. Runge (Minnesota Mining and Mfg. Co., Saint Paul.) *In* NASA, Lewis Research Center, NASA Laser Light Scattering Advanced Technology Development Workshop, 1988 Aug. 1989 p 215-227 (For primary document see N90-17085 09-35)
Avail: NTIS HC A14/MF A02 CSCL 14B

Microgravity offers a unique environment for studying polymer diffusion and polymer polymerization reactions. The absence of convection currents, which are the major mode of mixing at the molecular level on Earth, are eliminated or reduced in the microgravity environment. More importantly, the prediction of unique copolymer composition development in microgravity allows controlled formation of new compositions of matter. The absence of mixing at the molecular level should produce unique short block copolymers available for the first time for comonomer compositions which normally lead to random or long block copolymer under good mixing. The investigation of fundamental polymer diffusion and polymer polymerization processes in microgravity is proposed. This effort will involve fundamental studies of monomer and polymer diffusion; their effects on initiation, propagation, and especially termination kinetics rate constant; and the accurate evaluation of copolymerization reactivity ratios in microgravity. The experimental design is presented for these studies along with an evaluation technique for in situ monitoring of polymer diffusion and polymerization kinetics. Author

N90-17101*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
POLYMER SOLUTION PHASE SEPARATION: MICROGRAVITY SIMULATION c27
Lawrence C. Cerny (Utica Coll., NY.) and James K. Sutter *In its* NASA Laser Light Scattering Advanced Technology Development Workshop, 1988 Aug. 1989 p 229-234 (For primary document see N90-17085 09-35)
Avail: NTIS HC A14/MF A02 CSCL 11C

In many multicomponent systems, a transition from a single phase of uniform composition to a multiphase state with separated regions of different composition can be induced by changes in temperature and shear. The density difference between the phase and thermal and/or shear gradients within the system results in buoyancy driven convection. These differences affect kinetics of the phase separation if the system has a sufficiently low viscosity. This investigation presents more preliminary developments of a theoretical model in order to describe effects of the buoyancy driven convection in phase separation kinetics. Polymer solutions were employed as model systems because of the ease with which density differences can be systematically varied and because of the importance of phase separation in the processing and properties of polymeric materials. The results indicate that the kinetics of the phase separation can be performed viscometrically using laser light scattering as a principle means of following the process quantitatively. Isopycnic polymer solutions were used to determine the viscosity and density difference limits for polymer phase separation. Author

N90-17102*# Alabama Univ., Birmingham. Dept. of Physiological Optics and Optometry.
PROTEIN CRYSTAL GROWTH IN MICROGRAVITY c29
William M. Rosenblum, Lawrence J. DeLucas, and William W. Wilson (Mississippi State Univ., Mississippi State.) *In* NASA, Lewis Research Center, NASA Laser Light Scattering Advanced Technology Development Workshop, 1988 Aug. 1989 p 235-256 (For primary document see N90-17085 09-35)
Avail: NTIS HC A14/MF A02 CSCL 22A

Major advances have been made in several of the experimental aspects of protein crystallography, leaving protein crystallization as one of the few remaining bottlenecks. As a result, it has become important that the science of protein crystal growth is better understood and that improved methods for protein crystallization are developed. Preliminary experiments with both small molecules and proteins indicate that microgravity may beneficially affect crystal growth. For this reason, a series of protein crystal growth experiments using the Space Shuttle was initiated. The preliminary space experiments were used to evolve prototype hardware that will form the basis for a more advanced system that can be used to evaluate effects of gravity on protein crystal growth. Various optical techniques are being utilized to monitor the crystal growth process from the incipient or nucleation stage and throughout the growth phase. The eventual goal of these studies is to develop a system which utilizes optical monitoring for dynamic control of the crystallization process. Author

N90-17103# Institut Franco-Allemand de Recherches, Saint-Louis (France).
LASER VELOCIMETER SEED PARTICLE SIZING BY THE WHISKER PARTICLE COLLECTOR AND LASER AEROSOL SPECTROMETER METHODS
F. L. Crosswy, M. K. Kingery (Arnold Engineering Development Center, Arnold Air Force Station, TN.), H. J. Schaefer, and H. J. Pfeifer 28 Jul. 1989 86 p Sponsored by Direction des Recherches, Etudes et Techniques, Paris, France and Centre de Documentation de l'Armement
(PB90-111287; ISL-R-117/88) Avail: NTIS HC A05/MF A01 CSCL 14B

Two different aerosol particle sizing systems, the Whisker Particle Collector (WPC) and the Laser Aerosol Spectrometer (LAS), were evaluated for sizing aerosol particles in the size range of 0.1 to 3.0 micrometers. The evaluation tests were conducted using an aerosol of alumina (Al2O3) particles, an aerosol commonly used to provide light scattering particles for laser velocimeter measurements in high temperature flows. The LAS and WPC measurements were then compared for samples taken from the alumina particle aerosols. Some difficulty was encountered in directly comparing these measurements. Other operational aspects of the two systems were also compared including on-line/off-line data presentation capabilities, field portability and measurement limitations at the small particle end of the size range of interest. GRA

N90-17104*# National Aeronautics and Space Administration. Pasadena Office, CA.
BALLAST SYSTEM FOR MAINTAINING CONSTANT PRESSURE IN A GLOVE BOX Patent Application

Paul J. Shlichta, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 29 Sep. 1989 13 p
(Contract NAS7-918)
(NASA-Case-NPO-17786-1-CU; NAS 1.71:NPO-17786-1-CU; US-Patent-Appl-SN-414812) Avail: NTIS HC A03/MF A01 CSCL 14B

A ballast system is disclosed for a glove box including a fixed platform on which is mounted an inflatable bag on top of which resides a cover and a weight. The variable gas volume of the inflatable bag communicates with that of the glove box via a valved tube. The weight and the gas volume are selected to maintain a relatively constant pressure in the glove box despite variations in the glove box volume while avoiding the use of complicated valving apparatus. NASA

N90-17105*# Cornell Univ., Ithaca, NY. Dept. of Computer Science.
IMPLEMENTING FAULT-TOLERANT SENSORS
Keith Marzullo May 1989 23 p Submitted for publication
(Contract NAG2-593; N00140-87-C-8904; ARPA Order 6037)
(NASA-CR-186269; NAS 1.26:186269; TR-89-997) Avail: NTIS HC A03/MF A01 CSCL 14B

One aspect of fault-tolerance in process control programs is the ability to tolerate sensor failure. This paper presents a methodology for transforming a process control program that cannot tolerate sensor failures to one that can. Additionally, a hierarchy of failure models is identified. Author

N90-17106# General Atomic Co., San Diego, CA.
RECENT LEAK TELESCOPE DEVELOPMENT
M. V. Fisher, T. H. Jensen, and F. A. Puhn Dec. 1989 5 p Presented at the 13th IEEE Symposium on Fusion Engineering, Knoxville, TN, 2-6 Oct. 1989
(Contract DE-AC03-89ER-51114)
(DE90-004101; GA-A-19738; CONF-891007-103) Avail: NTIS HC A01/MF A01

Conventional leak testing methods used to pinpoint the location of a leak become impossible whenever circumstances prevent local application of helium or other tracer gases to the outside surface of a vacuum system. This situation occurs frequently on tokamaks and other fusion devices due to close-fitting external hardware and/or vacuum vessel wall design, such as sandwich construction of inner and outer skins welded to corrugations. A solution to this type of leak detection problem is the leak telescope, a device still in the developmental stage, which detects leaks by sensing the direction of molecular flow from inside a vacuum system. Actually, the device senses all types of flow, whether it be from areas of high outgassing or virtual leaks as well as leaks from real surface penetrations. Using earlier work as a basis, a detailed model for describing the leak telescope was developed. An experimental setup was also developed to test the model. Experimental results show that a fairly primitive leak telescope can detect the position of relatively small leaks (i.e., 1 x 10(exp -5) torr-l/s) at large distances (i.e., 1m) in high vacuum (i.e., 1 x 10(exp -7) torr). DOE

N90-17107# Geo-Centers, Inc., Newton, MA.
MICRO-MINIATURE ROLL RATE SENSOR Final Report, Mar. 1987 - Aug. 1989
Jonathan Grant, Bruce Nelson, and George Garnes 17 Nov. 1989 81 p
(Contract DAAA21-87-C-0066)
(AD-A214778; GC-89-FR-1702-002; ARFSD-CR-89018) Avail: NTIS HC A05/MF A01 CSCL 17/8

The Phase 2 Micro-Miniature Roll Rate Sensor Program developed an optical centripetal accelerometer that can be tailored to work over a wide range of accelerations. A rate sensing device was developed by measuring centripetal acceleration due to rotation with a proof mass loading a photoelastic sensing element. The acceleration is proportional to the amount of birefringence induced by the load. Development of this technology resulted in construction of a prototype rate sensor targeted for use with the Copperhead munition. The sensors developed in this program can be adjusted for the desired range of operation through changes in width of a photoelastic (plastic) sensing element and/or changes in the amount of proof mass used to load the sensing element. Radial location of the sensor can also be used to control the range. GRA

N90-17108# North Carolina Univ., Chapel Hill. Dept. of Computer Science.
ON THE GEOMETRY OF A GENERAL THREE-CAMERA HEADMOUNTED SYSTEM
John H. Halton Apr. 1989 45 p
(Contract N00014-86-K-0680)
(AD-A214790; TR89-019) Avail: NTIS HC A03/MF A01 CSCL 20/6

A 3-D scene, such as a proposed building, an imaginary landscape, or an organic molecule, is selected, described in abstract terms, and stored in a computer's memory. A person wears a special helmet, in a laboratory whose inner wall is dotted with landmark LEDs. The helmet is equipped with a location system and a projection system. As the wearer moves in the laboratory, changing the helmet's position (and orientation) in a natural manner, the location system allows the computer to keep track of the helmet's position, and the computer sends appropriate information to the projection system, to display the view of the selected scene (suitably scaled) that would be seen by the wearer during this motion. GRA

N90-17109# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
NON-FOURIER COMPUTER GENERATED HOLOGRAPHY FOR 3-D DISPLAY M.S. Thesis
Tommy A. Mouser Nov. 1989 59 p
(AD-A215369; AFIT/GCS/ENG/89D-13) Avail: NTIS HC A04/MF A01 CSCL 14/1

Computer Generated Holograms are used for a variety of purposes. One promising approach is to use them to provide three dimensional views of an object. The methods currently in use to develop computer generated holograms use the Fast Fourier Transform and are not geared toward developing three dimensional images. A method is developed to produce a computer generated hologram by implementing an equation almost identical to that of the general form of scalar diffraction theory. This method will theoretically allow computer generated holograms to be made for a wider range of objects. The interference pattern for a cube was calculated using this method. An electron beam lithography machine was used to transform this pattern to a glass plate. GRA

N90-17110# Cornell Univ., Ithaca, NY. Dept. of Chemistry.
A SMALL, INEXPENSIVE APPARATUS FOR THE DETERMINATION OF THE DENSITY OF POWDERED MATERIALS
M. Y. Chern, R. D. Mariani, D. A. Vennos, and Francis J. DiSalvo 17 Nov. 1989 13 p Sponsored in part by DOE
(Contract N00014-88-K-0139)
(AD-A215393; TR-3) Avail: NTIS HC A02/MF A01 CSCL 14/2

A small inexpensive apparatus for measuring the density of powders at an accuracy of 1 percent or better is presented. Since the working medium is a gas, the density of air or solvent sensitive samples can easily be measured with this apparatus in a glove box. The measurement of density by the conventional liquid immersion technique for materials that are powders is usually difficult to perform and prone to large errors. The main problems are caused by gas trapped between particle grains, the lack of wetting of the solid by the liquid, and possibly chemical reaction between the solid and the liquid. A standard closed volume is connected to a pressure transducer and to a calibrated piston. The closed volume is formed by covering a hole drilled in a metal block with a plate and o-ring so that a sample may be included inside. The apparatus is first calibrated when the closed volume contains only gas (near atmospheric pressure) and no sample.

The piston is moved a fixed distance to produce a volume change. GRA

N90-17111# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
INVESTIGATION OF A MAGNETOSTRICTIVE FIBER OPTIC INTERFEROMETRIC SENSOR M.S. Thesis
R. Dempsey Hackett Dec. 1989 189 p
(AD-A215666; AFIT/GEO/ENG/89D-4) Avail: NTIS HC A09/MF A01 CSCL 17/6

The results are reported which were associated with a magnetostrictive fiber optic interferometric sensor which was fabricated and evaluated. To evaluate the sensor's performance, a Helmholtz coil was designed and constructed to generate a uniform magnetic field. The sensor's response was determined by examining the amplitude of the interferometer's output light. No dc magnetic fields could be detected due to excessive noise contributed by fused coupler component in the interferometer.The ac measurements were successfully accomplished for a 25 Hz magnetic field by inspecting the modulation of the interferometer's output light at 25 Hz. Sensors composed of RF sputtered metal coated fibers did not detect the ac magnetic field because the thin metal films did not generate enough force to change the length of the optical fiber a detectable amount. The sensor did detect the ac magnetic field when the sensor arm was composed of a bulk nickel rod. Thermal annealing the nickel rod in the presence of an external magnetic field improved the sensor's response. Thinning the optical fiber in the sensor arm did not significantly affect the sensor's performance, but increasing the length of the optical fiber did enhance the sensor's response. The sensor's performance also improved when the ac magnetic field was superimposed on a dc bias magnetic field. In the sensor's optimum configuration, and ac magnetic field flux density of 10 mG was detected. GRA

N90-17112*# Eloret Corp., Sunnyvale, CA.
SHOCK LAYER VACUUM UV SPECTROSCOPY IN AN ARC-JET WIND TUNNEL
G. Palumbo Jan. 1990 17 p Presented at the 35th International Instrumentation Symposium, Orlando, FL, 30 Apr. - 4 May 1988
(NASA-TM-102258; A-90017; NAS 1.15:102258) Avail: NTIS HC A03/MF A01 CSCL 14B

An experimental program is being developed to obtain measurements of the incident surface radiation in the 1000 A to 2000 A range from the shock stagnation region of a blunt model in the Ames 20 MW Arc-Jet Wind Tunnel. The setup consists of a water-cooled blunt model, with a magnesium fluoride forward-viewing window. Radiation incident on the window is optically imaged via an evacuated system and reflective optical elements onto the entrance slit of a spectrograph. The model will be exposed to the supersonic plasma stream from the exit nozzle of the arc-jet tunnel. The resulting bow shock radiation will be measured. It is expected that this experiment will help evaluate the importance of atomic N and O lines to the radiative heating of future Aeroassist Space Transfer Vehicles (ASTVs). Author

N90-17113# Institut Franco-Allemand de Recherches, Saint-Louis (France).
SELF COMPENSATION OF RIGID DISPLACEMENTS IN HOLOGRAPHIC INTERFEROMETRY [AUTOCOMPENSATION DES DEPLACEMENTS RIGIDES EN INTERFEROMETRIE HOLOGRAPHIQUE]
A. Stimpfling 30 Jun. 1988 10 p In FRENCH Presented at the OPTO 88 Conference, Paris, France, 17-18 May 1988
(ISL-CO-219/88; ETN-90-96086) Avail: NTIS HC A02/MF A01

A method called integral holographic initialization is used to compensate perfectly the displacements of the whole object, and to compensate for local deformation. It allows the recording of interferograms obtained by time integration of a moving vibrating target. The experiments carried out with a continuous laser show that the method compensates completely and automatically any displacement of any amplitude of the target object. The application to study defects in aircraft structures in discussed. ESA

N90-17114# Institut Franco-Allemand de Recherches, Saint-Louis (France).
DOPPLER IMAGERY FOR THE VISUALISATION OF VELOCITY FIELDS [IMAGERIE DOPPLER POUR LA VISUALISATION DE CHAMPS DE VITESSE]
J. Srulijes, A. George, and F. Seiler 28 Sep. 1988 17 p In FRENCH Presented at Journees Francaises d'Anemometrie Laser, Marseille, France, 21-23 Sep. 1988
(ISL-CO-232/88; ETN-90-96091) Avail: NTIS HC A03/MF A01

The method described is based on Michelson interferometry and it allows the visualization and measurement of the velocity fields using only one photograph. The Doppler image furnishes information in the form of frequency variations, which are transformed in the Michelson interformeter in variations of light intensity. A Doppler camera is described. Images of supersonic jets, shock waves and turbulences are included. ESA

N90-17115# Institut Franco-Allemand de Recherches, Saint-Louis (France).
APPLICATION OF HOLOGRAPHY TO BEHAVIOR SIMULATORS [APPLICATION DE L'HOLOGRAPHIE DANS LES SIMULATEURS DE CONDUITE: ETUDE DES DIFFERENTS TYPES D'HOLOGRAMMES]
F. Albe 13 Jul. 1988 23 p In FRENCH
(Contract BMVg-T/R-760/H-0015/H-1715)
(ISL-R-111/88; ETN-90-96101) Avail: NTIS HC A03/MF A01

The technical aspects of the various hologram realization technologies are reviewed and compared with regard to its utilization in behavior simulators. The rainbow type holograms and the reflection holograms appear the best suited for that application. A cineholographic sequence is simulated using both techniques. The quality attainable is not yet sufficient for the mentioned application. ESA

N90-17116# Institut Franco-Allemand de Recherches, Saint-Louis (France).
A FEASIBILITY STUDY FOR USING CARS IN TEMPERATURE AND VOLUMETRIC MEASUREMENT AS A FUNCTION OF TIME [UNTERSUCHUNGEN ZUR DURCHFUEHRBARKEIT ZEITAUFGELOESTER DICHTE- UND TEMPERATURMESSUNGEN MITTELS CARS]
A. Eichhorn 16 Aug. 1988 20 p In GERMAN Presented at the DPG Fruehjahrstagung des Fachausschusses Kurzzeitphysik, Duesseldorf, Federal Rep. of Germany, 29 Feb. - 4 Mar. 1988
(ISL-CO-223/88; ETN-90-96088) Avail: NTIS HC A03/MF A01

Improvements in Coherent Anti-Stokes Raman Spectroscopy (CARS) are described. The poor temporal resolution of CARS has been improved by the use of lasers with a much higher pulse rate. The feasibility of using CARS to measure combustion generated flow is discussed. A pulse rate of 1 KHz is used. The energy fluctuations in the CARS system using two parallel beams are investigated. Background noise in the sensors is shown to greatly influence the precision of measurements. ESA

N90-17117* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
SKIN FRICTION BALANCE Patent
Tcheng Ping, inventor (to NASA) and Frank H. Supplee, Jr., inventor (to NASA) 6 Jun. 1989 9 p
(NASA-Case-LAR-13710-1; US-Patent-4,836,035; US-Patent-Appl-SN-210487; US-Patent-Class-73-862.61; US-Patent-Class-73-147) Avail: U.S. Patent and Trademark Office CSCL 14B

A skin friction balance uses a parallel linkage mechanism to avoid inaccuracies in skin friction measurement attributable to off-center normal forces. The parallel linkage mechanism includes a stationary plate mounted in a cage, and an upper and lower movable plate which are linked to each other and to the stationary plate throught three vertical links. Flexure pivots are provided for pivotally connecting the links and the plates. A sensing element connected to the upper plate moves in response to skin friction, and the lower plate moves in the opposite direction of the upper

plate. A force motor maintains a null position of the sensing element by exerting a restoring force in response to a signal generated by a linear variable differential transformer (LVDT).
Official Gazette of the U.S. Patent and Trademark Office

N90-17118* National Aeronautics and Space Administration. Pasadena Office, CA.
TAILORABLE INFRARED SENSING DEVICE WITH STRAIN LAYER SUPERLATTICE STRUCTURE Patent
Li-Jen Cheng, inventor (to NASA) (California Inst. of Tech., Pasadena.) 27 Jun. 1989 10 p
(NASA-Case-NPO-16617-2-CU; US-Patent-4,843,439; US-Patent-Appl-SN-125676; US-Patent-Class-357-4; US-Patent-Class-357-30; US-Patent-Class-357-13; US-Patent-Class-357-61) Avail: U.S. Patent and Trademark Office CSCL 14B

An infrared photodetector is formed of a heavily doped p-type Ge(x)Si(1-x)/Si superlattice in which x is pre-established during manufacture in the range 0 to 100 percent. A custom tailored photodetector that can differentiate among close wavelengths in the range of 2.7 to 50 microns is fabricated by appropriate selection of the alloy constituency value, x, to establish a specific wavelength at which photodetection cut-off will occur.
Official Gazette of the U.S. Patent and Trademark Office

N90-17170# Defense Nuclear Agency, Kirkland AFB, NM.
STATE-OF-THE-ART OF MEASURING GROUND SHOCK AND CRATERING PHENOMENA
E. J. Rinehart *In* Vibration Inst., The Shock and Vibration Digest, Volume 21, No. 9 Sep. 1989 p 20-24 (For primary document see N90-17168 09-39)
Avail: NTIS HC A05/MF A01

36 LASERS AND MASERS

Includes parametric amplifiers.
For related information see also *76 Solid-State Physics.*

N90-17119# Fagin Systems Associates, Inc., Wynnewood, PA.
LASER WAVE ESTIMATION
S. L. Fagin 15 Sep. 1989 35 p Revised
(Contract N00014-88-C-6031)
(AD-A213867) Avail: NTIS HC A03/MF A01 CSCL 08/3

A contract was awarded for the exploration of the potential of an airborne laser for the estimation of wave height. The approach taken was to reproduce old results. It soon became apparent that the simple and economical three or four state models used in earlier work were inadequate and a full fifteen state model for a P3C aircraft was employed. The results of varying wind gust standard deviation, wind gust correlation time, and the standard deviation of combined wave height and measurement error are described. As long wave lengths, characteristics of deep ocean, were also of interest, a model variation was employed to separate wave height and measurement error. The effect of varying pulse repetition rate and beam rotation rate are discussed. GRA

N90-17120# Japan Atomic Energy Research Inst., Tokyo. Dept. of Thermonuclear Fusion Research.
ENERGY CONVERSION EFFICIENCY IN HIGH CURRENT RAMAN REGIME FREE ELECTRON LASER (FEL). 1: SINGLE MODE ANALYSIS
Yasuaki Kishimoto, Makoto Shiho, Kazuo Odajima, Hikosuke Maeda, and Hisako Oda (Kanazawa Computer Service Corp., Japan) Jul. 1989 30 p
(DE90-719527; JAERI-M-89-088) Avail: NTIS (US Sales Only) HC A03/MF A01

The effect of the longitudinal electrostatic field on the energy conversion efficiency is investigated by use of a 1-dimensional FEL amplification code. It is found that the repulsive electrostatic interaction prevents the periodic bounce motion of trapped electrons in the ponderomotive potential especially in the high current Raman operation regime. The irregular rotation of the trapped electron increases the untrapped ones, which obtained the kinetic energy from the radiation field. Resultantly, the energy conversion efficiency averaged over a long wiggler distance stays in a lower level than that predicted by the trapping argument. It is also found that the finite beam energy spread reduces the electrostatic force in the nonlinear trapping stage. The reduction of the electrostatic force recovers the periodic electron bounce motion and the associated amplitude oscillation of the radiation field. DOE

N90-17121# Japan Atomic Energy Research Inst., Tokyo. Dept. of Thermonuclear Fusion Research.
ONE-DIMENSIONAL SINGLE-MODE NONLINEAR FEL AMPLIFICATION CODE: USER'S MANUAL
Yasuaki Kishimoto and Hisako Oda (Kanazawa Computer Service Corp., Japan) May 1989 63 p In JAPANESE; ENGLISH summary
(DE90-719544; JAERI-M-89-061) Avail: NTIS (US Sales Only) HC A04/MF A01

The 1-dimensional single mode nonlinear FEL amplification code is developed which is useful for the basic design of Free Electron Laser. The wiggler field is given by the helical configuration, and the guide magnetic field for the stable beam propagation and the incident beam energy spread are taken into account. The tapered-wiggler with arbitrary configuration is also considered. The nonlinear FEL characteristics in the wide range from Compton to Raman regimes are analyzed since the electrostatic interaction between particles is included. The FEL code developed here is vectorized about 97%. Therefore, the large amount of parameter study for the optimization of machine design is possible. DOE

N90-17122# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
THEORETICAL AND EXPERIMENTAL INVESTIGATION OF COUPLED Ar-ION LASERS Ph.D. Thesis
Mark P. Jelonek Oct. 1989 156 p
(AD-A214908; AFIT/DS/ENP/89-3) Avail: NTIS HC A08/MF A01 CSCL 09/3

A single mode laser theory was applied to two coupled Ar-ion lasers in Fabry-Perot resonators and the equations were solved numerically to predict intensity tuning curves and locking ranges for various types of mirror translations. The same theory was extended to model two modes in each cavity, which predicted a decrease in locking range as well as a mutually-reinforced hole burning minimum. With a single, uncoupled two mode He-Ne laser, the existence of the minimum was verified experimentally. Two multiline/multimode Ar-ion lasers were coupled through a common end mirror and the effect of coupling strength on phase locking was investigated by varying the reflectivity of that mirror. To mode coupling, interference fringe visibilities, output power, and the frequency and RF mode beat spectra were measured. The optimal phase locking occurred at about 25 percent coupling as determined by the maximum fringe visibilities produced by laser phase locking. That 25 percent coupling was the optimum coupling strength was also substantiated by fact that the maximum power output was also achieved at this point, and the appearance of the super cavity mode spacing verified that the behavior was due to phase locking. A passive cavity mode analysis of the three mirror Fabry-Perot resonator showed the system oscillated on the composite resonator frequency as well as the frequencies of both sub-resonators. GRA

N90-17123# Colorado State Univ., Fort Collins. Dept. of Electrical Engineering.
CW ULTRAVIOLET LASER EXCITED WITH AN ELECTRON BEAM Final Report, 1 Jul. 1987 - 30 Jun. 1989
Jorge J. Rocca Oct. 1989 59 p
(Grant AF-AFOSR-0290-87; AF Proj. 2301)
(AD-A214928; AFOSR-89-1422TR) Avail: NTIS HC A04/MF A01 CSCL 09/3

Laser oscillation was obtained in the 318 nm transition of AgII. Excitation of the laser upper level occurs by charge transfer

collisions between ground state neon ions created by electron beam ionization and silver atoms. CW laser oscillation was also obtained in the 478.8 line of AgII. GRA

N90-17124# Air Force Systems Command, Wright-Patterson AFB, OH. Foreign Technology Div.
DESIGN PRINCIPLES OF THE LVT-2 MODEL LASER INSTRUMENT FOR THE MEASUREMENT OF VISUAL CHARACTERISTICS
Wende Sun 24 Oct. 1989 8 p Transl. into ENGLISH from Zhongguo Juguang (Peoples Republic of China), v. 13, no. 9, 1986 p 571-572
(AD-A214951; FTD-ID(RS)T-0575-89) Avail: NTIS HC A02/MF A01 CSCL 06/12

As far as the LVT-2 model laser visual acuity measuring instrument, after its model improvement, is concerned, it not only is capable of measuring the visual acuity of retina (LVA), but also capable of measuring the MTF of retina. The light path system of the instrument has three sections. One is a double light bundle common path interference system making use of double Dufu prisms to divide bundles. In conjunction with this, it uses the movement of a reflection lens M2 in order to change the interval distance of the two mutually interfering bundles. As a result of this, it changes the spacial frequency of the interference bands. This acts as the light path to measure LVA. The second is the background light set composed of such components as the tungsten filament lamp T sub L, the interference filter optical plate OF, and the polarization lens P2. It is used in order to form, on the retina, a uniform background base light. In conjunction with this, through adjustments of the dispersion prism B in the light path, adjustments are made in the degree of contrast change I sub O/I sub u measuring the MTF of the retina. GRA

N90-17125# Department of the Navy, Washington, DC.
APPARATUS FOR THE EFFICIENT WAVELENGTH CONVERSION OF LASER RADIATION Patent Application
Myung K. Chun, inventor (to Navy), Lew Goldberg, inventor (to Navy), and Joseph F. Weller, inventor (to Navy) 26 Jun. 1989 19 p
(AD-D014314; US-Patent-Appl-SN-370965) Avail: NTIS HC A03/MF A01 CSCL 09/3

An apparatus for generating coherent radiation at a desired frequency is disclosed. In a preferred embodiment the apparatus comprises: an injection-locked semiconductor diode structure having a large active area for emitting a diffraction-limited beam at a preselected frequency; optics for focusing the diffraction-limited beam into a focused beam; a nonlinear crystal responsive to the focused beam for producing a beam of laser power which includes an output beam at a desired harmonic of the preselected frequency; and a device for passing the output beam in a given direction. In a modification of the preferred embodiment, the output of the injection-locked semiconductor diode structure is mixed with an emission from a laser source in the nonlinear crystal to produce a desired sum or difference frequency. GRA

N90-17126# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
GROUND-BASED DEEP-SPACE LADAR FOR SATELLITE DETECTION: A PARAMETRIC STUDY M.S. Thesis
Kevin F. Davey Dec. 1989 153 p
(AD-A215673; AFIT/GSO/ENP/ENS/89D-1) Avail: NTIS HC A08/MF A01 CSCL 17/5

The minimum performance requirements are determined of a ground based infrared LADAR designed to detect deep space satellites, and a candidate sensor design is presented based on current technology. The research examines LADAR techniques and detection methods to determine the optimum LADAR configuration, and then assesses the effects of atmospheric transmission, background radiance, and turbulence across the infrared region to find the optimum laser wavelengths. Diffraction theory is then used in a parametric analysis of the transmitted laser beam and received signal, using a Cassegrainian telescope design and heterodyne detection. The effects of beam truncation and obscuration, heterodyne misalignment, off-boresight detection, and image-pixel geometry are also included in the analysis. The derived equations are then used to assess the feasibility of several candidate designs under a wide range of detection conditions including daylight operation through cirrus. The results show that successful detection is theoretically possible under most conditions by transmitting a high power frequency modulated pulse train from an isotopic 13CO2 laser radiating at 11.17 micrometers, and utilizing post-detection integration and pulse compression techniques. GRA

N90-17127# Mississippi State Univ., Mississippi State. Diagnostic Instrumentation and Analysis Lab.
DEVELOPMENT AND APPLICATION OF DIAGNOSTIC INSTRUMENTATION FOR MEASUREMENTS OF ELECTRON DENSITY AND CONDUCTIVITY Semiannual Technical Progress Report, 3 Aug. 1988 - 31 Mar. 1989
L. E. Bauman Aug. 1989 9 p
(Contract DE-AC22-88PC-88652)
(DE90-004076; DOE/PC-88652/T1) Avail: NTIS HC A03/MF A01

The purpose is to assemble and demonstrate in the laboratory a Faraday rotation system for measurement of electron density and conductivity. The intent is to produce a system suitable for diagnostic support of the development of pulsed, space-based magnetohydrodynamic (MHD) power systems. The work during the period August 3, 1988 to March 31, 1989, concerned Contract Task 1.A. (analysis and characterization of laboratory MHD flow properties for the choice of the laser wavelength) which was completed November 30, 1988; Contract Task 1.B. (design and construction of optical components) which was completed February 28, 1989; and Contract Task 1.C. (system assembly) which is underway. DOE

N90-17128# Los Alamos National Lab., NM.
IDENTIFICATION AND REDUCTION OF WAKEFIELD EFFECTS IN THE WIGGLER REGION OF THE LOS ALAMOS FREE-ELECTRON LASER
A. H. Lumpkin, D. W. Feldman, R. W. Warren, W. E. Stein, and D. Chan 1989 19 p Presented at the 11th International Free Electron Laser Conference, Naples, FL, 28 Aug. - 1 Sep. 1989
(Contract W-7405-eng-36)
(DE90-004871; LA-UR-89-4267; CONF-8908134-21) Avail: NTIS HC A03/MF A01

Improving the performance of the Los Alamos Free Electron Laser (FEL) in 1988 involved the identification and reduction of Wakefield effects generated in the wiggler region. The Wakefield effect was dramatically reduced by inserting a smooth metal tube into the wiggler gap, and the FEL performance was concomitantly improved. DOE

N90-17129# Los Alamos National Lab., NM.
IMPROVED PERFORMANCE OF THE BOEING/LANL FEL (FREE-ELECTRON LASER) EXPERIMENT: EXTRACTION EFFICIENCY AND CAVITY LENGTH DETUNING EFFECTS
A. H. Lumpkin, R. L. Tokar, D. H. Dowell, A. R. Lowrey, A. D. Yeremian, and R. E. Justice (Edgerton, Germeshausen and Grier, Inc., Los Alamos, NM.) 1989 30 p Presented at the 11th International Free Electron Laser Conference, Naples, FL, 28 Aug. - 1 Sep. 1989 Sponsored in part by Army Strategic Defense Command
(Contract W-7405-eng-36)
(DE90-004872; LA-UR-89-4268; CONF-8908134-22) Avail: NTIS HC A03/MF A01

Significant improvement was observed in the performance of the Boeing/LANL Free Electron Laser (FEL) experiment in the last year. Some of the more graphic demonstrations of this improved performance are presented in the time-resolved optical spectral measurements (streak/spectrometer) and the electron beam spectral measurements. Extraction efficiency of about 1/4 percent for the uniform wiggler and nearly 1 percent for the tapered wiggler experiment was obtained. DOE

N90-17130# Lawrence Livermore National Lab., CA. Beam Research Program.
THREE-DIMENSIONAL SIMULATION OF FREE-ELECTRON LASER HARMONICS WITH FRED
W. M. Sharp, E. T. Scharlemann, and W. M. Fawley 20 Nov. 1989 18 p Presented at the 11th International Free Electron Laser Conference, Naples, FL, 28 Aug. - 1 Sep. 1989
(Contract W-7405-eng-48)
(DE90-005253; UCRL-101074; CONF-8908134-23) Avail: NTIS HC A03/MF A01

FRED3D, a single-mode three-dimensional version of the FEL simulation code FRED, was modified to follow the growth of signal components at the fundamental frequency and at even and odd harmonics. The Wiggle-averaged particle and field equations for this multi-mode formulation are derived here, and their implementation in FRED3D is discussed. DOE

N90-17131# Sandia National Labs., Albuquerque, NM.
GASDYNAMIC PHENOMENA IN NUCLEAR-REACTOR-PUMPED LASERS
J. R. Torczynski 1989 21 p Presented at the International Conference on Lasers '89, New Orleans, LA, 3-8 Dec. 1989
(Contract DE-AC04-76DP-00789)
(DE90-005428; SAND-89-1889C; CONF-891261-1) Avail: NTIS HC A03/MF A01

In nuclear-reactor-pumped lasers, the fission-fragment heating is spatially nonuniform and as such induces gas motion. The competing effects of heating nonuniformity and thermal conduction on overall gas motion and laser optical behavior are examined, and a parameter is developed which categorizes the induced gas flow into three regimes. The effect of fission-fragment heating on perturbations in the gas density field is also examined, and a scaling relation describing the reduction of the rms density perturbation is developed in terms of the pressure rise produced by the heating. DOE

N90-17132* National Aeronautics and Space Administration. Pasadena Office, CA.
NONCONTACT TEMPERATURE PATTERN MEASURING DEVICE Patent
Daniel D. Elleman, inventor (to NASA), James L. Allen, inventor (to NASA), and Mark C. Lee, inventor (to NASA) (California Inst. of Tech., Pasadena.) 20 Jun. 1989 11 p
(NASA-Case-NPO-17824-1-CU; US-Patent-4,840,496; US-Patent-Appl-SN-159613; US-Patent-Class-374-124; US-Patent-Class-356-43; US-Patent-Class-374-126; US-Patent-Class-374-130) Avail: U.S. Patent and Trademark Office CSCL 20E

Laser pyrometer techniques are utilized to accurately image a true temperature distribution on a given target without touching the target and without knowing the localized emissivity of the target. The pyrometer utilizes a very high definition laser beam and photodetector, both having a very narrow focus. The pyrometer is mounted in a mechanism designed to permit the pyrometer to be aimed and focused at precise localized points on the target surface. The pyrometer is swept over the surface area to be imaged, temperature measurements being taken at each point of focus.
Official Gazette of the U.S. Patent and Trademark Office

N90-17086*# Kiel Univ. (Germany, F.R.).
LASER LIGHT SCATTERING REVIEW
Klaus Schaetzel *In* NASA, Lewis Research Center, NASA Laser Light Scattering Advanced Technology Development Workshop, 1988 Aug. 1989 p 1-23 (For primary document see N90-17085 09-35)
Avail: NTIS HC A14/MF A02 CSCL 20E

N90-17091*# Case Western Reserve Univ., Cleveland, OH. Dept. of Chemical Engineering.
MAXIMUM LIKELIHOOD TECHNIQUES IN QELS
Robert V. Edwards *In* NASA, Lewis Research Center, NASA Laser Light Scattering Advanced Technology Development Workshop, 1988 Aug. 1989 p 99-118 (For primary document see N90-17085 09-35)
Avail: NTIS HC A14/MF A02 CSCL 20E

N90-17092*# Akron Univ., OH. Dept. of Chemical Engineering.
IMPROVED OPTICS FOR LASER LIGHT SCATTERING
H. Michael Cheung *In* NASA, Lewis Research Center, NASA Laser Light Scattering Advanced Technology Development Workshop, 1988 Aug. 1989 p 119-133 (For primary document see N90-17085 09-35)
Avail: NTIS HC A14/MF A02 CSCL 20E

N90-17097*# Exxon Research and Engineering Co., Annandale, NJ.
LASER LIGHT SCATTERING AS A PROBE OF FRACTAL COLLOID AGGREGATES
David A. Weitz and M. Y. Lin *In* NASA, Lewis Research Center, NASA Laser Light Scattering Advanced Technology Development Workshop, 1988 Aug. 1989 p 173-183 Prepared in cooperation with City Univ. of New York, NY (For primary document see N90-17085 09-35)
Avail: NTIS HC A14/MF A02 CSCL 20E

37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

N90-17133 Arizona State Univ., Tempe.
SOME PROBLEMS IN HYDRODYNAMIC LUBRICATION Ph.D. Thesis
Nagaraj K. Arakere 1988 191 p
Avail: Univ. Microfilms Order No. DA8907682

Several computational and mathematical modelling problems in the areas of compressible and incompressible hydrodynamic lubrication are addressed. The first problem involves application of the collocation method for static and dynamic analyses of finite-length gas journal bearings. The method is shown to be an order of magnitude computationally faster than the finite difference method. Transient and steady-state unbalance response of the journal center is obtained for finite-length gas-journal bearings by solving the compressible Reynolds equation for journal bearings. The technique, in principle, can also be extended to slider and tilting-pad bearings. Squeeze-film dampers of finite-length with variable clearance is next investigated using the collocation method. It is shown that by suitably varying the two parameters that control the nature of axial clearance variation, the secant stiffness and damping coefficient variation with journal eccentricity ratio can be altered to better suit specific design needs. The collocation method is shown to be a viable and efficient method for static and dynamic analyses of the incompressible lubrication of squeeze-film dampers. Surface roughness effects on the hydrodynamic lubrication characteristics of finite-length gas journal bearings are studied next by numerically solving the ensemble averaged compressible Reynolds equation. The last problem deals with gas-lubricated finite-length foil-journal bearings. Dissert. Abstr.

N90-17134 Michigan Univ., Ann Arbor.
DYNAMIC MODELING OF FLEXIBLE BODIES IN MULTIBODY SYSTEMS Ph.D. Thesis
Hong Hee Yoo 1989 152 p
Avail: Univ. Microfilms Order No. DA8920642

The objective of this research is the development of analytical and computational methods for analyzing the effects of motion-induced stiffness variations on the dynamic behavior of mechanical multibody system composed of structural components undergoing arbitrarily large, unrestrained, overall motions as well as small elastic deformations. The importance of the subject is indicated by the fact that components of dynamic multibody mechanical systems are often assumed to possess nearly constant stiffness properties, even though rather benign overall motions can, in some important applications, cause enough variation in

stiffness to have dramatic effects on dynamic behavior. Thus, incomplete accounting for such variations can yield completely erroneous analysis results. As newer designs for spacecraft, robotic manipulators, and mechanisms call for lighter weight and faster operational speeds, the topic assumes even greater importance as characteristic stiffness vary significantly for these extremely flexible systems. The focus of the present research is the study of structural stiffness variations caused by inertia forces and torques, a main goal being to formulate an efficient and effective technique for accounting for all such stiffness changes in a general multibody simulation theory which incorporate flexible body control schemes and arbitrary forcing functions. Dissert. Abstr.

N90-17135*# Texas Univ., Austin. Spacecraft and Mission Design Group.
A MARS/PHOBOS TRANSPORTATION SYSTEM Final Report
10 May 1989 216 p
(Contract NASw-4435)
(NASA-CR-186217; NAS 1.26:186217) Avail: NTIS HC A10/MF A02 CSCL 13F

A transportation system will be necessary to support construction and operation of bases on Phobos and Mars beginning in the year 2020 or later. An approach to defining a network of vehicles and the types of vehicles which may be used in the system are presented. The network will provide a convenient, integrated means for transporting robotically constructed bases to Phobos and Mars. All the technology needed for the current plan is expected to be available for use at the projected date of cargo departure from the Earth system. The modular design of the transportation system provides easily implemented contingency plans, so that difficulties with any one vehicle will have a minimal effect on the progress of the total mission. The transportation network proposed consists of orbital vehicles and atmospheric entry vehicles. Initially, only orbital vehicles will participate in the robotic construction phase of the Phobos base. The Interplanetary Transfer Vehicle (ITV) will carry the base and construction equipment to Phobos where the Orbital Maneuvering Vehicles (OMV's) will participate in the initial construction of the base. When the Mars base is ready to be sent, one or more ITV's will be used to transport the atmospheric entry vehicles from Earth. These atmospheric vehicles are the One Way Landers (OWL's) and the Ascent/Descent Vehicles (ADV's). They will be used to carry the base components and/or construction equipment. The OMV's and the Orbital Transfer Vehicles (OTV's) will assist in carrying the atmospheric entry vehicles to low Martian orbit where the OWL's or ADV's will descent to the planet surface. The ADV's were proposed to accommodate expansion of the system. Additionally, a smaller version of the ADV class is capable of transporting personnel between Mars and Phobos. Author

N90-17136*# Draper (Charles Stark) Lab., Inc., Cambridge, MA.
REMOTE MANIPULATOR SYSTEM (RMS)-BASED CONTROLS-STRUCTURES INTERACTION (CSI) FLIGHT EXPERIMENT FEASIBILITY STUDY Final Report, Oct. 1988 - Jul. 1989
Martha E. Demeo Oct. 1989 84 p
(Contracts NAS9-17560; NAS9-18147)
(NASA-CR-185600; NAS 1.26:185600; CSDL-R-2186) Avail: NTIS HC A05/MF A01 CSCL 13I

The feasibility of an experiment which will provide an on-orbit validation of Controls-Structures Interaction (CSI) technology, was investigated. The experiment will demonstrate the on-orbit characterization and flexible-body control of large flexible structure dynamics using the shuttle Remote Manipulator System (RMS) with an attached payload as a test article. By utilizing existing hardware as well as establishing integration, operation and safety algorithms, techniques and procedures, the experiment will minimize the costs and risks of implementing a flight experiment. The experiment will also offer spin-off enhancement to both the Shuttle RMS (SRMS) and the Space Station RMS (SSRMS). Author

N90-17137*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
METHOD AND APPARATUS FOR POSITIONING A ROBOTIC END EFFECTOR Patent Application
Cliff Hess, inventor (to NASA) and Larry C. H. Li, inventor (to NASA) 10 Aug. 1989 24 p
(NASA-Case-MSC-21476-1; NAS 1.71:MSC-21476-1; US-Patent-Appl-SN-392235) Avail: NTIS HC A03/MF A01 CSCL 13I

A robotic end effector and operation protocol for a reliable grasp of a target object irrespective of the target's contours is disclosed. A robotic hand includes a plurality of jointed fingers, one of which, like a thumb, is in opposed relation to the other. Each finger is comprised of at least two jointed sections, and provided with reflective proximity sensors, one on the inner surface of each finger section. Each proximity sensor comprises a transmitter of a beam of radiant energy and means for receiving reflections of the transmitted energy when reflected by a target object and for generating electrical signals responsive thereto. On the fingers opposed to the thumb, the proximity sensors on the outermost finger sections are aligned in an outer sensor array and the sensors on the intermediate finger sections and sensors on the innermost finger sections are similarly arranged to form an intermediate sensor array and an inner sensor array, respectively. The invention includes a computer system with software and/or circuitry for a protocol comprising the steps in sequence of: (1) approach axis alignment to maximize the number of outer layer sensors which detect the target; (2) non-contact contour following the target by the robot fingers to minimize target escape potential; and (3) closing to rigidize the target including dynamically re-adjusting the end effector finger alignment to compensate for target motion. A signal conditioning circuit and gain adjustment means are included to maintain the dynamic range of low power reflection signals. NASA

N90-17138*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
MECHANIZED FLUID CONNECTOR AND ASSEMBLY TOOL SYSTEM Patent Application
Ronald C. Zentner, inventor (to NASA) and Steven A. Smith, inventor (to NASA) (Boeing Aerospace Co., Seattle, WA.) 9 Nov. 1989 16 p
(NASA-Case-MSC-21434-1; NAS 1.71:MSC-21434-1; US-Patent-Appl-SN-433881) Avail: NTIS HC A03/MF A01 CSCL 13I

A fluid connector system is disclosed which includes a modified plumbing union having a rotatable member for drawing said union into a fluid tight condition. A drive tool is electric motor actuated and includes a reduction gear train providing an output gear engaging an integral peripheral spur gear on the rotatable member. Coaxial alignment means are attached to both the connector assembly and the drive tool. A hand lever actuated latching system includes a plurality of circumferentially spaced latching balls selectively wedged against the alignment means attached to the connector assembly or to secure the drive tool with its output gear in mesh with the integral peripheral spur gear. The drive motor is torque, speed, and direction controllable. NASA

N90-17139# Gupta (Pradeep K.), Inc., Clifton Park, NY.
TRACTION MODELING OF MILITARY LUBRICANTS Final Report, Sep. 1986 - May 1989
Pradeep K. Gupta 24 Aug. 1989 208 p
(Contract F33615-86-C-2096; AF Proj. 3005)
(AD-A213866; G-107-89-TR; WRDC-TR-89-2064) Avail: NTIS HC A10/MF A02 CSCL 20/11

Traction behavior of military lubricants is investigated by examining both classical Newtonian and more recently postulated visco-elastic effects in the experimental traction data. An estimate of the relevant rheological parameters is derived by curve fitting the experimental traction data to predictions of the analytical models. The development process consists of several steps: (1) a regression analysis of experimental viscosity data obtained by a high-pressure viscometer is first carried out to formulate a

viscosity-pressure-temperature relation, (2) analytical models for prediction of lubricant film thickness and traction are then developed and implemented in the form of a computer code, (3) the traction behavior of selected lubricants is measured experimentally over a range of operating conditions, (4) analysis of the traction data is then undertaken to derive the relevant rheological parameters for best fit of the data to the analytical models, and (5) finally, the traction models are incorporated in a bearing dynamics computer code, and the bearing performance is simulated as a function of the rheological parameters. It is shown that the traction data fits fairly well to visco-elastic models based on lubricant shear modulus and a critical shear stress. While the modulus defines the traction slope at low slip rates, the critical shear stress determines the limiting traction coefficient at high slip rates. GRA

N90-17140# Sandia National Labs., Albuquerque, NM. Thermomechanical and Physical Div.
RELATIONSHIP OF FRAGMENT SIZE TO NORMALIZED SPALL STRENGTH FOR MATERIALS
L. C. Chhabildas, L. M. Barker, J. R. Asay, and T. G. Trucano 1989 18 p Presented at the Hypervelocity Impact Symposium, San Antonio, TX, 12-14 Dec. 1989
(Contract DE-AC04-76DP-00789)
(DE90-004165; SAND-89-0594C; CONF-891214-15) Avail: NTIS HC A03/MF A01

A systematic study is described which addresses the technical issues associated with launching plates to hypervelocities using compressed helium gas as the driving medium. Similar acceleration rates are used to drive constant-mass flier plates, while the material properties such as the shock impedance, yield strength, and spall strength are varied. Results of these experiments indicate that, due to the severity of loading, the flier plates have a tendency to fragment following peak acceleration. Each material has its own unique fragment distribution. More significantly, these experiments suggest a direct dependence of the mean fragment size to its normalized spall strength, i.e., the spall strength divided by its density. A method is also proposed for successfully launching intact plates to hypervelocities. DOE

N90-17141# Sandia National Labs., Albuquerque, NM.
SMALL SCREW STUDY: FASTENER TENSILE STRENGTH AND OPTIMUM THREAD DEPTH Interim Report
Kathleen V. Diegert, Larry R. Dorrell, Robert T. Reese, and Lloyd J. Lazarus (Allied-Signal Aerospace Co., Kansas City, MO.) Oct. 1989 132 p
(Contract DE-AC04-76DP-00789)
(DE90-005001; SAND-89-1320) Avail: NTIS HC A07/MF A01

About 1260 tests performed on small threaded fasteners (equal to or less than 1/4 inch in diameter and designated as 1/4-20 UNC, 4-40 UNC, 2-56 UNC, and 1.0 UNM) are summarized. Tests determined the tensile strengths of the screws, the lengths of engagement needed to develop the full tensile strengths when the screws were engaged in 6061-T6 Aluminum, Hiperco 50, and 303 Stainless Steel, and whether relationships existed between the tensile strengths and Knoop Micro-Hardness measurements taken on the threaded ends of the screws. DOE

N90-17142# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
APPLICATIONS OF A FINGERTIP SENSOR FOR THE SALISBURY ROBOT HAND
David L. Brock 20 Jul. 1989 37 p
(Contracts DE-AC04-76DP-00789; SNL-75-2608)
(DE90-005002; SAND-88-7159) Avail: NTIS HC A04/MF A01

Work performed on tasks 1 through 3 under Sandia Contract Number 75-2608 is summarized. Task 1 involves a description of the sensor, its development and performance. Task 2 extends sensor applications to friction measurement and slip detection. Task 3 is an analysis of simple grasping reflexes particularly related to physical characteristics of the object and the manipulator. DOE

N90-17143# California Univ., Davis. Dept. of Mechanical Engineering.
CLASSIFICATION AND SIMULATION OF SINGLE AND MULTI-DEGREE-OF-FREEDOM MOTIONS Final Report, 1 Oct. 1988 - 31 Sep. 1989
Bahram Ravani 30 Oct. 1989 38 p
(Contract DAAL03-88-K-0206)
(AD-A214925; ARO-26122.2-EG) Avail: NTIS HC A03/MF A01 CSCL 12/9

An outline is provided of the results obtained in a period of one year in Simulation and Dynamic Motions (trajectories) of robot manipulators performing multi-degree-of-freedom motions. The design of a general purpose world modeling system for Computer Aided Design based robot motion simulation was completed. Methods were also developed for calibration of the world model to account for simple inaccuracies developed in the actual robot task operations. Methods were also developed to generate dynamic robot motions delivering maximum impulse at the end of a trajectory. This can be used in military applications involving automated ammunition loading. GRA

N90-17144# Kentucky Univ., Lexington.
TAYLOR IMPACT TESTING Final Report, Jun. 1987 - Jan. 1989
Joel W. House Sep. 1989 128 p
(Contract F08635-87-C-0125; AF Proj. 2502)
(AD-A215018; AD-E801980; AFATL-TR-89-41) Avail: NTIS HC A07/MF A01 CSCL 19/4

The reaction of armor to penetration by a projectile is an interesting and important area of science. To assist the armor and armor penetrator designers, several penetration models have been developed. These models require data on the behavior of material under high strain rate conditions resulting from impact. In a paper published in 1948, G. I. Taylor proposed an impact experiment and concomitant analysis to help interpret dynamic material behavior. This experimental technique remains in general use today even though there have been many attempts over the years to modify Taylor's analysis of the test. Ultimately, the data obtained from such Taylor tests are used in models of penetration. This report presents a critical discussion of Taylor test, some of the experimental setups for its performance, and one current analysis of the test. In addition, actual experimental results are presented and analyzed, and the resulting impact induced material microstructures are studied. GRA

N90-17145# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
MULTIPLEXED ROBOTIC TACTILE SENSOR FABRICATED FROM POLYVINYLIDENE FLUORIDE FILM M.S. Thesis
Douglas G. Ford Dec. 1989 180 p
(AD-A215354; AFIT/GE/ENG/89D-13) Avail: NTIS HC A09/MF A02 CSCL 12/9

The design, fabrication and evaluation of a multiplexed robotic tactile sensor fabricated from polyvinylidene fluoride (PVDF) film was investigated. A 16x16 electrode array was designed, each electrode encompassing a 250 x 250 microns square area, separated by a distance of 150 microns. A resident analog multiplexer was designed to assist in the acquisition of electrical signals from the array. Inherent within the multiplexer were analog transmission gates which provided a bidirectional flow of charge to each electrode. This provided a means of initializing the bias state of the PVDF film prior to the application of a load. GRA

N90-17146# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
MULTIPLE MODEL ADAPTIVE ESTIMATION TECHNIQUES FOR ADAPTIVE MODEL-BASED ROBOT CONTROL M.S. Thesis
Samuel J. Sablan Dec. 1989 158 p
(AD-A215742; AFIT/GE/ENG/89D-45) Avail: NTIS HC A08/MF A01 CSCL 25/5

The use of robotic manipulators for future Air Force applications will require a manipulator capable of emulating the performance

of the human arm. To emulate human arm motion, a robot must be capable of adapting quickly and accurately to changes in the environment while maintaining accurate high speed tracking performance. One approach to adaptive robotic control is the use of Multiple Model Adaptive Estimation (MMAE) techniques within a model-based control structure. The MMAE techniques employ a bank of Kalman filters whose models are based on different assumed values of the uncertain parameters. Using this bank of filters, the MMAE provides an estimate of the uncertain parameters. A previous development used a closed-loop form of MMAE with a model-based controller and was called Multiple Model-Based Control (MMBC). Further analysis of the MMBC showed it has limited applications to manipulators whose dynamics and tracking performance depend heavily on the payload. This is not the case for the PUMA-560 manipulator. As a result, a new form of adaptive model-based control called Open-Loop Multiple Model-Based Control (OL/MMBC) was developed. The OL/MMBC combines a model-based controller with a MMAE algorithm whose filters are based on an open-loop linearized perturbation model. The OL/MMBC was simulated and experimentally evaluated on a PUMA-560 manipulator. GRA

N90-17147*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
COMPARISON OF DROP SIZE DISTRIBUTIONS FROM TWO DROPLET SIZING SYSTEMS
John R. Oldenburg and Robert F. Ide (Army Aviation Research and Development Command, Cleveland, OH.) 1990 18 p Presented at the 2nd International Congress on Optical Particle Sizing, Phoenix, AZ, 5-9 Mar. 1990; sponsored by Arizona State Univ. and NSF Prepared in cooperation with Army Aviation Research and Development Command, Cleveland, OH
(DA Proj. 1L1-62209-AH-47A)
(NASA-TM-102520; E-5324; NAS 1.15:102520; AVSCOM-TM-90-C-001) Avail: NTIS HC A03/MF A01 CSCL 13I

A comparison between the Phase Doppler Particle Analyzer and the combined measurements from Particle Measuring Systems' Forward Scattering Spectrometer Probe and the Optical Array Probe was conducted in an icing wind tunnel using NASA Icing Research Tunnel spray nozzles to produce the supercooled water droplet cloud. Clouds having a range of volume median diameters from 10 to greater than 50 microns were used for the instrument comparisons. A volume median diameter was calculated from combining the droplet distributions of the Optical Array Probe and the Forward Scattering Spectrometer Probe. A comparison of the combined volume median diameters and the Phase Doppler Particle Analyzer volume median diameters showed agreement from 10 microns up to 30 microns. Typical drop size distributions from the Phase Doppler Particle Analyzer, the Forward Scattering Spectrometer Probe, and Optical Array Probe are presented for several median volume diameters. A comparison of the distributions illustrates regions of the distributions where there is good agreement and other regions where there are discrepancies between the Phase Doppler Particle Analyzer and the Particle Measuring Systems' droplet size instruments. Author

N90-17148 ESDU International Ltd., London (England).
FILM THICKNESS IN LUBRICATED HERTZIAN CONTACTS. PART 2: POINT CONTACTS Abstract Only
Dec. 1989 31 p
(ESDU-89045; ISBN-0-85679-719-7; ISSN-0141-2590) Avail: ESDU

ESDU 89045 provides a step-by-step calculation procedure for predicting the minimum lubricant film thickness in concentrated contacts that occur, for example, in rolling element bearings, variable traction drives and meshing gears. It applies to contact of metallic, plastic or ceramic components lubricated by any fluid. Tables are included of appropriate properties of various materials and lubricants for use in the procedure. Guidance is given on assessing the adequacy of the film thickness in various applications and on redesigning the contact where the predicted thickness is inadequate. The procedure is completely general, but simplifications are also given, for example, when the lubricant is entrained along an axis of the contact ellipse. A calculation sheet assists in the application of the method, and its use is illustrated through three practical worked examples. ESDU

N90-17149 ESDU International Ltd., London (England).
FRICTION IN BEARINGS Abstract Only
Dec. 1989 25 p
(ESDU-89044; ISBN-0-85679-718-9; ISSN-0141-2590) Avail: ESDU

ESDU 89044 gives guidance on the coefficient of friction to be expected in a wide range of industrial bearings. Where appropriate, a sketch gives, for a particular example of each type, the behavior of the coefficient as the load per unit area and the peripheral speed vary. Rubbing bearings considered include metallic, polymer and carbon/graphite materials rubbing against metallic or ceramic counterfaces, and solid lubricant and boundary lubricated bearings are also treated. Comments are also made about porous metal bearings. On full film bearings both oil-lubricated hydrodynamic and hydrostatic bearings are treated. Rolling bearings are also considered, the example being a deep-groove radial ball bearing, and a section treats wheels and rollers which may be used in overhead cranes, conveyors and bridge expansion joints for example. ESDU

N90-17150 ESDU International Ltd., London (England).
A COMPARISON OF TECHNIQUES FOR BALANCING PLANAR LINKAGES Abstract Only
Nov. 1989 23 p
(ESDU-89043; ISBN-0-85679-717-0; ISSN-0141-4046) Avail: ESDU

ESDU 89043 gives guidance on selecting in given circumstances the most appropriate balancing technique to eliminate or reduce both the shaking force and the shaking moment on a planar linkage. Design criteria on which a rational choice depends are discussed, and, by means of a tabular presentation, each of eleven separate techniques can be assessed against the requirements of a particular application. The principle underlying each technique is explained and sketches illustrate their practical application. The methods covered are of three types: link mass distribution (for example, by adding counterweights), the addition of moving links (for example, adding an identical linkage with mirror-image symmetry) and the addition of rotating or oscillating masses (for example, the Lanchester balancer). In practice, two or more of the techniques may be combined and a table indicates possible such combinations. ESDU

N90-17151# Pennsylvania State Univ., University Park. Dept. of Mechanical Engineering.
CHEMICAL EFFECT OF FUEL COMPOSITION CHANGES ON EMISSIONS FROM A DI DIESEL ENGINE
T. A. Litzinger 1989 71 p
(Contracts DE-AC05-84OR-21400; ORNL-86X-SB020V)
(DE90-004466; ORNL/Sub-86-SB020/1) Avail: NTIS HC A04/MF A01

The use of alternative fuels in Diesel engines has revealed shortcomings in the understanding of the effects of fuel properties and the combustion process on the formation of emissions. A significant amount of research in engines and simpler combustion devices was performed that identifies fuel properties which correlate with certain emission trends. Both the chemical composition of the fuel and its physical properties were found to affect combustion and emissions. Unfortunately, previous studies often produced conflicting results due to simultaneous variation of fuel properties or due to lack of proper control of the combustion process. Thus, research is needed which isolates specific fuel properties and varies them independently while carefully controlling the combustion process to eliminate it as a variable. DOE

N90-17152# Laboratorio de Computacao Cientifica, Rio de Janeiro (Brazil).
STRESS ANALYSIS IN PRESSURE VESSELS BY MIXED FINITE ELEMENT METHODS TAKING INTO ACCOUNT SHEAR DEFORMATION
Leopoldo P. Franca, Elson M. Toledo, Abimael F. D. Loula, and Eduardo L. M. Garcia Dec. 1988 16 p
(DE90-606755; LNCC-045/88) Avail: NTIS (US Sales Only) HC A03/MF A01

A new finite element method is employed to approximate axisymmetric shell problems. This formulation enhances stability and accuracy, from thin to moderately thick shells, compared to the correspondent Galerkin finite element approximations. Numerical results illustrate the good performance of the present method on some typical pressure vessels applications. DOE

N90-17153* National Aeronautics and Space Administration. Pasadena Office, CA.
ARTICULATED SUSPENSION SYSTEM Patent
Donald B. Bickler, inventor (to NASA) 20 Jun. 1989 7 p
(NASA-Case-NPO-17354-1-CU; US-Patent-4,840,394; US-Patent-Appl-SN-184236; US-Patent-Class-280-677; US-Patent-Class-280-682) Avail: U.S. Patent and Trademark Office CSCL 13I

The invention provides a rough terrain vehicle which maintains a substantially constant weight, and therefore traction, on all wheels, despite one wheel moving considerably higher or lower than the others, while avoiding a very soft spring suspension. The vehicle includes a chassis or body to be supported and a pair of side suspensions at either side of the body. In a six wheel vehicle, each side suspension includes a middle wheel, and front and rear linkages respectively coupling the front and rear wheels to the middle wheel. A body link pivotally connects the front and rear linkages together, with the middle of the body link rising or falling by only a fraction of the rise or fall of any of the three wheels. The body link pivotally supports the middle of the length of the body. A transverse suspension for suspending the end of the body on the side suspensions includes a middle part pivotally connected to the body about a longitudinal axis and opposite ends each pivotally connected to one of the side suspensions along at least a longitudinal axis.
Official Gazette of the U.S. Patent and Trademark Office

N90-17154* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
RELEASABLE CLAMPING APPARATUS Patent
W. Neill Myers, inventor (to NASA) 6 Jun. 1989 11 p
(NASA-Case-MFS-28192-1; US-Patent-4,836,707; US-Patent-Appl-SN-093417; US-Patent-Class-403-322; US-Patent-Class-403-325; US-Patent-Class-403-328; US-Patent-Class-292-27; US-Patent-Class-292-34; US-Patent-Class-24-635) Avail: U.S. Patent and Trademark Office CSCL 13I

In accordance with this invention, a releasable clamping apparatus was constructed having an opening or slot within which a lifting handle is clamped between retaining latch portions and a clamp assembly. The latch portions are supported by openings and are retracted and extended into a slot by spring biased linkage members. These members are acted upon by similarly profiled cam lobes. Dissimilarly profiled cam lobes of the cam member act upon the clamp assembly, clamping a hangle against faces of the latch portions. The cam member is coupled to a shaft having an operating handle with the shaft also being provided with a detent assembly. This detent assembly locks the handle and the shaft in locked positions in the surface of the apparatus, which clamps a handle as described. When the handle is rotated to position the detent assembly is one of the release openings, the clamp assembly and the latch portions are withdrawn into their respective openings, releasing the handle.
Official Gazette of the U.S. Patent and Trademark Office

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N90-17155 California Univ., Santa Barbara.
ON SOME PROBLEMS IN RELIABILITY THEORY Ph.D. Thesis
Jyoti Narayan Zalkikar 1988 127 p
Avail: Univ. Microfilms Order No. DA8910222

Classes of life distributions reflecting a particular ageing property play a prominent role in reliability theory. Here, various inference problems relating to some of these classes of distributions are studied. The first topic concerns the weak convergence of a U-statistic process focussing mainly on its application to testing exponentiality versus (nonexponential) increasing failure rate average distributions. The asymptotic normality of the test statistic is established. Its asymptotic relative efficiency with respect to the tests previously proposed in the literature is shown to be higher for a wide class of alternatives. Monte Carlo powers of the test for small samples also point in the same direction. Some of the results are extended to include the case of randomly right censored data, and the efficiency loss due to censoring is studied compared to the tests for the uncensored case. The second topic of the dissertation is the problem of estimating the measure of deviation of F from exponentiality towards NBU alternatives, denoted by Delta(F), in Bayes and empirical Bayes set-ups. A Bayes estimator of Delta(F) is derived using the squared error loss function and Dirichlet process prior for F. A limiting version of this estimator, under some conditions on the parameter of the process, is shown to be asymptotically normal. Dissert. Abstr.

N90-17156# Rizhskij Nauchno-Issledovatelskij Inst., Riga (USSR). Radioizotopnogo Priborostroeniya.
APPLICATION OF X RAY FLUORESCENCE METHOD TO MEASURING THICKNESS OF GALVANIC COATINGS AND MEASURES OF IMPROVING SENSITIVITY OF SUCH MEASURINGS
Yu. D. Lisin and B. N. Vejts 1988 13 p In RUSSIAN
(DE89-633351; RNIIRP-88-3) Avail: NTIS (US Sales Only) HC A03/MF A01

Possibilities of the X-ray fluorescence method in solving type designs for testing thickness of galvanic coatings and its advantages as compared to the (beta)-backscattering method by analyzing random measurement errors, inherent to both methods, are experimentally shown. Using gold coatings on nickel base the efficiency of a method of sensitivity improvement due to application of a selective filter decreasing the measurement errors of the X-ray fluorescence method. DOE

N90-17157*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
MAGELLAN/GALILEO SOLDER JOINT FAILURE ANALYSIS AND RECOMMENDATIONS
Ronald G. Ross, Jr. 15 Sep. 1989 46 p
(Contract NAS7-918)
(NASA-CR-186294; NAS 1.26:186294; JPL-Publ-89-35) Avail: NTIS HC A03/MF A01 CSCL 14D

On or about November 10, 1988 an open circuit solder joint was discovered in the Magellan Radar digital unit (DFU) during integration testing at Kennedy Space Center (KSC). A detailed analysis of the cause of the failure was conducted at the Jet Propulsion Laboratory leading to the successful repair of many pieces of affected electronic hardware on both the Magellan and Galileo spacecraft. The problem was caused by the presence of high thermal coefficient of expansion heat sink and conformal coating materials located in the large (0.055 inch) gap between Dual Inline Packages (DIPS) and the printed wiring board. The details of the observed problems are described and recommendations are made for improved design and testing activities in the future. Author

N90-17158# University of Southern California, Los Angeles. Dept. of Electrical Engineering.
BASIC RESEARCH IN RELIABILITY FOR REAL SYSTEMS Annual Technical Report, 1 Aug. 1988 - 31 Jul. 1989
Victor O. K. Li 1 Sep. 1989 7 p
(Grant AF-AFOSR-0259-88; AF Proj. 2304)
(AD-A214536; AFOSR-89-1352TR) Avail: NTIS HC A02/MF A01 CSCL 12/3

The research objective is to develop practical models and efficient algorithms to analyze and evaluate the reliability, availability, and maintainability of complex systems in which component failures are statistically dependent and each component is subject to degradations before complete failure. The Event-Based Reliability Model (EBRM) was developed for the reliability modeling and analysis of real systems in which component failures are statistically dependent. Most existing reliability models assume that system component failures are statistically independent. This assumption, though it greatly simplifies the problem, is often not valid, and the result is usually an overestimation of network reliability. A model was also developed to approximate the reliability of systems with multimode components. Previous research on reliability has been focused on models which assume that each component may be in one of two modes, namely, operative or failed. In real life, a component may undergo degradations in performance before a complete outage, and will therefore operate in more than two modes. More recently, the Cause-Based Multimode Model (CBMM) was developed, which allows one to consider failure dependencies of components which are subject to degradations. GRA

N90-17159# Army Armament Research and Development Command, Dover, NJ. Product Assurance Directorate.
EDDY CURRENT TEST FOR BOLTS Final Report
Syed Ali Nov. 1989 64 p Presented at the 37th Defense Conference on Nondestructive Testing, Jacksonville, FL, 1-3 Nov. 1988
(AD-A214829; ARPAD-TR-89003) Avail: NTIS HC A04/MF A01 CSCL 13/5

The signal strength and the phase angle of the eddy current indication is a function of metal integrity, stand off yield strength, hardness, grain structure, and electrical conductivity. This concept was used to differentiate between grade 5, 8, and 8.2 bolts. The statistical analysis of the data obtained shows a high degree of correlation between bolt grade and eddy current indications. Tests were also conducted to detect 5 percent surface cracks of various orientation and locations using the same eddy current setup. It is concluded that eddy current technique can be used as a reliable inspection method to detect cracks and to differentiate between different grades of bolts. GRA

N90-17160# California Univ., Davis. Div. of Statistics.
NONPARAMETRIC ESTIMATION OF RELIABILITY AND RELATED FUNCTIONS Final Report, 1 Jul. 1985 - 30 Jun. 1989
Jane-Ling Wang 25 Jul. 1989 16 p
(Grant AF-AFOSR-0268-85; AF Proj. 2304)
(AD-A215138; AFOSR-89-1584TR) Avail: NTIS HC A02/MF A01 CSCL 12/3

Several nonparametric inference problems including two-sample tests, linear regression and estimation of distribution and related functions such as density and hazard rate functions are examined. Estimators with desired aging properties were constructed for IFRA and NBU distribution functions respectively based on randomly censored data and shown to be raised to the one half power equivalent to the product-limit estimator. Nonparametric maximum likelihood estimator and its strong consistency were also derived for an IFR distribution for unidentifiable cause-of-failure data. Local asymptotic properties (strong consistency, asymptotic normality and mean squared error) of the kernel density and hazard rate estimators were obtained via a recent i.i.d. representation of the product-limit estimator. The results on kernel estimates were applied to obtain point and interval estimates of the change-point of a hazard rate function. Several median type two-sample test procedures which allows early termination of the study were constructed. GRA

N90-17161# Missouri Univ., Columbia. Dept. of Statistics.
STATISTICAL THEORY OF RELIABILITY Final Report, Apr. 1987 - May 1989
Asit P. Basu 31 May 1989 7 p
(Grant AF-AFOSR-0139-87; AF Proj. 2304)
(AD-A215320; AFOSR-89-1307TR) Avail: NTIS HC A02/MF A01 CSCL 12/3

Accelerated life testing of a product is commonly used to reduce test time and costs. Accelerated testing is achieved by subjecting the test units to conditions that are more severe than the normal ones. The results obtained at the more severe conditions are then extrapolated to normal conditions to obtain an estimate of life distribution under normal condition. This problem is considered when the product is a 2-component system with lifetimes following the bivariate exponential distribution of Block and Basu (1974). Here our interest is in the joint analysis of data with two failure times. GRA

N90-17162# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
PROJECT MANAGEMENT IN SUCCESSFUL RELIABILITY AND MAINTAINABILITY IMPROVEMENT PROGRAMS M.S. Thesis
Diane E. Suchan Sep. 1989 94 p
(AD-A215424; AFIT/GLM/LSG/89S-62) Avail: NTIS HC A05/MF A01 CSCL 05/1

The Air Force regularly is involved in the management of programs to improve the Reliability and Maintainability (R and M) of its weapon systems. Proper management of these programs is critical if the R and M goals established in the program documentation are to be realized when the system is fielded. This research attempts to identify factors related to project management which may contribute to the success of an R and M improvement program. The eight factors studied were based on suggestions made in articles about R and M. They are top-level management support, clearly defined R and M requirements, training in R and M issues, the government-contractor working relationship, assignment of R and M responsibilities within the program office, incorporation of technological advances, use of contract incentives/warranties, and including R and M requirements in the RFP evaluation criteria. GRA

N90-17163# California Univ., Berkeley. Dept. of Industrial Engineering and Operations Research.
STOCHASTIC MODELS IN RELIABILITY Final Report, 1 Jun. 1986 - 31 Jul. 1989
Sheldon M. Ross Nov. 1989 11 p
(Grant AF-AFOSR-0153-86; AF Proj. 2304)
(AD-A215479; AFOSR-89-1388TR) Avail: NTIS HC A03/MF A01 CSCL 12/3

A variety of stochastic models in reliability were studied. Approximations in renewal theory and continuous time Markov chains were obtained by analyzing the relevant stochastic process at a gamma distributed rather than a fixed time. Some statistical problems related to software reliability were considered. GRA

N90-17164# Grumman Aerospace Corp., Bethpage, NY. Aircraft Systems Div.
R/M/T (RELIABILITY, MAINTAINABILITY, AND TESTABILITY) DESIGN FOR FAULT TOLERANCE, TECHNICAL MANAGER'S DESIGN IMPLEMENTATION GUIDE Final Technical Report, Oct. 1985 - Jul. 1988
Stanley J. Murn, Jr. Oct. 1989 211 p
(Contract F30602-85-C-0161; AF Proj. 2338)
(AD-A215531; RADC-TR-88-69-Vol-2) Avail: NTIS HC A10/MF A02 CSCL 13/8

Fault tolerance has come into almost universal use in modern day systems of all types. This report contains design guidance and general information for Air Force and contractor technical managers and system integrators with respect to the nature and

form of Reliability Maintainability Testability (RMT) considerations as they apply to fault tolerant systems. This technical managers design implementation guide contains instructions for accomplishing the RMT programmatic tasks of MIL-STDS 785, 470 and 2165 for fault tolerant systems development. Important fault tolerance design options and tradeoff analysis methods are discussed to aid the technical manager or system integrator in understanding and managing the entire fault tolerant system design process. GRA

N90-17165# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
VALIDATION OF AN EXPONENTIALLY DECREASING FAILURE RATE SOFTWARE RELIABILITY MODEL M.S. Thesis
Charles J. Westgate, III Sep. 1989 119 p
(AD-A215546; AFIT/GLM/LSY/89S-71) Avail: NTIS HC A06/MF A01 CSCL 12/5

The purpose was to determine the validity of a software reliability estimation model proposed by the Air Force Operational Test and Evaluation Center (AFOTEC). During the last forty years of the computer era, the demand for software has grown at a rate of twelve percent per year; and about fifty percent of the total life cycle cost of a software system is attributed to software fault increases dramatically as the life cycle progresses. It was statistics like those discussed above that prompted this research. The research had these specific objectives: the first was ascertaining the soundness of the models intrinsic logic. The second objective was to run the model with actual failure data to measure the validity and correlation of the data with the model. The final objective was to determine the assumptions required to operate the model. GRA

N90-17166# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
A GUIDE TO QUALITY ASSURANCE INDICATORS FOR THE DEFENSE ELECTRONICS INDUSTRY M.S. Thesis
Ronald A. Goertz Sep. 1989 114 p
(AD-A215630; AFIT/GSM/LSM/89S-12) Avail: NTIS HC A06/MF A01 CSCL 09/1

The purpose of this study was to provide the inexperienced quality assurance specialist (QAS) with a guide to quality assurance indicators for use when working with contractors in the defense electronics industry. The quality indicators used by two defense industry contractors (ITT and Texas Instruments) with excellent quality programs were studied, as were the indicators used by two of the AFSC product divisions (ESD and ASD) that interface with the defense electronics industry. This research focused on the elements of a MIL-Q-985A quality program required for the complex systems produced by the contractors studied. Quality indicators and observations about quality programs were discussed, presenting the uses, merits, and shortfalls of the elements of QAS might find in an ideal quality program. GRA

N90-17167*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SUBTLE POROSITY VARIATION IN THE YBa2Cu3O(7-x) HIGH-TEMPERATURE SUPERCONDUCTOR REVEALED BY ULTRASONIC IMAGING
D. J. Roth, E. R. Generazio, D. B. Stang (Sverdrup Technology, Inc., Cleveland, OH.), and A. F. Hepp Jan. 1990 11 p
(NASA-TM-102130; E-4917; NAS 1.15:102130) Avail: NTIS HC A03/MF A01 CSCL 14D

The characterization of global porosity variation within a nominally 93-percent-dense specimen of YBa2Cu3O(7-x) high-temperature superconductor is reported. With a computer-controlled scanning system, precision ultrasonic velocity measurements were obtained at 100 micron increments over an 8- by 8-mm area of the YBa2Cu3O(7-x) specimen. The measurements were used to form a color map of velocity variation across the scanned region of the specimen. Subtle velocity variation on the order of 1 percent was observed. The specimen was shown by experimental methods to be single-phase, untextured, and free of nonuniform residual microstresses. From this knowledge and an established velocity-density relationship, a likely conclusion is that the observed velocity variations are solely due to porosity variations of similar magnitude. Locating these subtle porosity variations is critical since they can result in an order of magnitude variation in J(sub c) for dense YBCO specimens. Thus, mapping the global porosity distribution within YBa2Cu3O(7-x) may reveal regions that have poorer superconducting properties. Ultrasonic velocity results are translated into useful microstructural information for the material scientist. Author

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

N90-17168# Vibration Inst., Clarendon Hills, IL.
THE SHOCK AND VIBRATION DIGEST, VOLUME 21, NO. 9 Monthly Report
Vicki M. Pate, ed. Sep. 1989 84 p
Avail: NTIS HC A05/MF A01

The feature article of this issue of the digest is entitled, Wind Excited Behavior of Structures 5. Another article entitled, State of the Art of Measuring Ground Shock and Cratering Phenomena, is the feature of the Testing Technology section. News briefs, book reviews, and abstracts from current literature are also presented. For individual titles, see N90-17169 through N90-17170.

N90-17169# Bradford Univ. (England).
WIND-EXCITED BEHAVIOR OF STRUCTURES, 5
D. J. Johns *In* Vibration Inst., The Shock and Vibration Digest, Volume 21, No. 9 Sep. 1989 p 3-19 (For primary document see N90-17168 09-39)
Avail: NTIS HC A05/MF A01

Recent literature on wind excited behavior of structures and related topics is reviewed. Among the phenomena considered are those due to vortex shedding, galloping, flutter, divergence and buckling, turbulence and fatigue. Theoretical and experimental (model and full scale) studies are included, as are techniques to alleviate wind excited behavior. Author

N90-17170# Defense Nuclear Agency, Kirkland AFB, NM.
STATE-OF-THE-ART OF MEASURING GROUND SHOCK AND CRATERING PHENOMENA **c35**
E. J. Rinehart *In* Vibration Inst., The Shock and Vibration Digest, Volume 21, No. 9 Sep. 1989 p 20-24 (For primary document see N90-17168 09-39)
Avail: NTIS HC A05/MF A01

The measurement of ground shock poses problems that are not typical of normal dynamic measurements, thus emphasis is placed on understanding the physical quantities involved in these measurements, rather than on details about the types of gages used for their performance. Three topics are covered; the measurement process, the measurement devices, and measurement validation. Author

N90-17171*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A STATISTICAL STUDY OF THE SURFACE ACCURACY OF A PLANAR TRUSS BEAM
W. Scott Kenner and W. B. Fichter Washington Feb. 1990 16 p
(NASA-TM-4161; L-16656; NAS 1.15:4161) Avail: NTIS HC A03/MF A01 CSCL 20K

Surface error statistics for single-layer and double-layer planar truss beams with random member-length errors were calculated using a Monte-Carlo technique in conjunction with finite-element analysis. Surface error was calculated in terms of the normal distance from a regression line to the surface nodes of the distorted beam. Results for both single-layer and double-layer beams indicate

that a minimum root-mean-square surface error can be achieved by optimizing the depth-to-length ratio of a truss beam. The statically indeterminate double-layer beams can provide greater surface accuracy, though at the expense of significantly greater complexity. Author

N90-17172 North Carolina State Univ., Raleigh.
DYNAMIC INTERACTIONS AND GLOBALLY OPTIMAL MANEUVER OF DISTRIBUTED SYSTEMS Ph.D. Thesis
Sungtae Park 1989 108 p
Avail: Univ. Microfilms Order No. DA8918985

Significant interactions between rigid body and flexible-body motions, and the globally optimal maneuver of distributed spacecraft undergoing large overall rigid-body maneuvers and small relative elastic motion are described. One distinguishes between the rigid-body and flexible-body motions by introducing a tracking coordinate system that coincides with the rigid-body component of the motion and by enforcing the motion relative to the tracking coordinate system (the elastic motion) to be orthogonal to the rigid-body motion. This leads to an infinite set of second-order weakly coupled modal differential equations describing the elastic motion. It is shown that the elastic motion is excited by the rigid body motion through Coriolis terms, angular acceleration terms and centrifugal terms. The Coriolis terms represent a linear time-varying gyroscopic effect, the angular acceleration terms represent a linear time varying circulatory effect and the centrifugal terms represent a linear time-varying stiffness effect. For unidirectional elastic motions, the Coriolis terms and the angular acceleration terms are shown to vanish. For uniform unidirectional elastic motion the centrifugal terms are diagonal and the modal equations become decoupled. Dissert. Abstr.

N90-17173*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
EIGENSOLUTION OF FINITE ELEMENT PROBLEMS IN A COMPLETELY CONNECTED PARALLEL ARCHITECTURE
Fred A. Akl and Michael R. Morel (Ohio Univ., Athens.) 1989 12 p Presented at the 30th Structures, Structural Dynamics, and Materials Conference, Mobile, AL, 3-5 Apr. 1989; cosponsored by AIAA, ASME, ASCE, AHS, and ACS
(NASA Order C-99066-G)
(NASA-TM-102450; E-5235; ICOMP-89-31; NAS 1.15:102450; AIAA-89-1395) Avail: NTIS HC A03/MF A01 CSCL 20K

A parallel algorithm for the solution of the generalized eigenproblem in linear elastic finite element analysis, (K)(phi) = (M)(phi)(omega), where (K) and (M) are of order N, and (omega) is of order q is presented. The parallel algorithm is based on a completely connected parallel architecture in which each processor is allowed to communicate with all other processors. The algorithm has been successfully implemented on a tightly coupled multiple-instruction-multiple-data (MIMD) parallel processing computer, Cray X-MP. A finite element model is divided into m domains each of which is assumed to process n elements. Each domain is then assigned to a processor, or to a logical processor (task) if the number of domains exceeds the number of physical processors. The macro-tasking library routines are used in mapping each domain to a user task. Computational speed-up and efficiency are used to determine the effectiveness of the algorithm. The effect of the number of domains, the number of degrees-of-freedom located along the global fronts and the dimension of the subspace on the performance of the algorithm are investigated. For a 64-element rectangular plate, speed-ups of 1.86, 3.13, 3.18 and 3.61 are achieved on two, four, six and eight processors, respectively. Author

N90-17174# Sydney Univ. (Australia). School of Civil and Mining Engineering.
ELASTIC BUCKLING OF IMPERFECT CYLINDRICAL SHELLS CONTAINING GRANULAR SOLIDS
J. M. Rotter and Q. Zhang Feb. 1989 37 p
(PB90-110362; R-589) Avail: NTIS HC A03/MF A01 CSCL 20K

Many steel silos and bins are circular in plan. Vertical (axial) compressive stresses are induced in the wall by the frictional drag of stored solids against the wall, and by non-symmetrical pressures on the wall. The design of the wall is usually governed by its strength against buckling under axial compression. The buckling strength is reduced by imperfections in the wall but increased again by internal pressure in the silo. These phenomena have been recognized and taken into account for some time. However, the silo wall may also be supported against buckling by the presence of the stored solid. The strengthening effect of the stored solid is the subject of this theoretical study. Experiments have shown that solids stored in silos increase the buckling strength because they have a finite stiffness (unlike a fluid). However, existing experiments are so limited in scope that it is difficult to use them in a quantitative manner. The aim of the report is to provide a theoretical background which may be used in the interpretation of future experiments. GRA

N90-17175# Materials Research Labs., Melbourne (Australia).
ANALYSIS OF SOME FRACTURE MECHANICS TEST PROCEDURES FOR DEFENCE RESEARCH APPLICATIONS
J. H. Underwood (Army Armament Research, Development and Engineering Center, Watervliet, NY.), I. A. Burch, and M. Z. ShahKhan 1990 32 p
(MRL-TR-89-11) Avail: NTIS HC A03/MF A01

Analysis was presented of six fracture mechanics specimens and associated test procedures. Stress intensity factor results, and displacement results in some cases, were compared for each specimen with numerical results and limit solutions from the literature. The specimens and test procedures analyzed are a compact specimen for general fracture testing, a crack arrest compact specimen, a modified compact specimen for brittle coating tests, a bend specimen for stress-corrosion cracking tests, a round bar bend specimen, and a tensile panel for composite material tests. Comparison with literature results was used to draw conclusions regarding accuracy of stress intensity factor and displacement relations for the specimens. Author

N90-17176# Japan Atomic Energy Research Inst., Tokyo. Dept. of High Temperature Engineering.
DEPRESSURIZATION TEST ON HOT GAS DUCT
Masanori Tanihira, Kazuhiko Kunitomi, Yoshiyuki Inagaki, Yutaka Sato (Okazaki Mfg. Co., Japan), and Yoshiaki Miyamoto May 1989 64 p In JAPANESE; ENGLISH summary
(DE90-710058; JAERI-M-89-051) Avail: NTIS (US Sales Only) HC A04/MF A01

To study the integrity of internal structures and the characteristics in a hot gas duct under the rapid depressurization accident, depressurization tests were carried out using a test apparatus installed on the hot gas duct with the same size and the same structures as that of the High Temperature Engineering Test Reactor (HTTR). The tests were performed with 3 parameters: depressurization rate (0.14 to 3.08 MPa/s) determined by orifice diameter, area of the open space at the slide joint (11.9 to 2036 sq mm) and initial pressure (1.0 to 4.0 MPa) filled up in a pressure vessel, by using nitrogen gas and helium gas. The maximum pressure difference applied on the internal structures of the hot gas duct was 2.69 MPa on the liner tube and 0.45 MPa on the separating plate. After all tests were completed, the hot gas duct which was used in the tests was disassembled. Inspection revealed that there were no failure and no deformation on the internal structures such as separating plates, insulation layers, a liner tube and a pressure tube. DOE

N90-17177*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
FATIGUE DELAMINATION ONSET PREDICTION IN TAPERED COMPOSITE LAMINATES
Gretchen Bostaph Murri, Satish A. Salpekar, and T. Kevin OBrien (Army Aerostructures Directorate, Hampton, VA.) Dec. 1989 62 p
(NASA-TM-101673; NAS 1.15:101673; AVSCOM-TM-89-B-011)
Avail: NTIS HC A04/MF A01 CSCL 20K

Tapered (0 deg) laminates of S2/CE9000 and S2/SP250

glass/epoxies, and IM6/1827I graphite/epoxy were tested in cyclic tension. The specimens usually showed some initial stable delaminations in the tapered region, but these did not affect the stiffness of the specimens, and loading was continued until the specimens either delaminated unstably, or reached 10(exp 6) to 2 x 10(exp 7) million cycles with no unstable delamination. The final unstable delamination originated at the junction of the thin and tapered regions. A finite-element model was developed for the tapered laminate with and without the initial stable delaminations observed in the tests. The analysis showed that for both cases the most likely place for an opening (Mode 1) delamination to originate is at the junction of the taper and thin regions. For each material type, the models were used to calculate the strain energy release rate, G, associated with delaminations originating at that junction and growing either into the thin region or tapered region. For the materials tested, cyclic G(sub Imax) values from DCB tests were used with the maximum strain energy release rates calculated from the finite-element analysis to predict the onset of unstable delamination at the junction as a function of fatigue cycles. The predictions were compared to experimental values of maximum cyclic load as a function of cycles to unstable delamination from fatigue tests in tapered laminates. For the IM6/1827I and S2/SP250 laminates, the predictions agreed very well with the test data. Predicted values for the S2/CE9000 were conservative compared to the test data. Author

N90-17178# BBN Systems and Technologies Corp., Canoga Park, CA.

NOISE AND SONIC BOOM IMPACT TECHNOLOGY. SONIC BOOM DAMAGE TO CONVENTIONAL STRUCTURES Final Report, Aug. 1987 - Aug. 1988

Jerald M. Haber and David Nakaki Feb. 1989 303 p

(Contract F33615-86-C-0530; AF Proj. 3037)

(AD-A213594; BBN-6829; HSD-TR-89-001) Avail: NTIS HC A14/MF A02 CSCL 20/11

United States Air Force supersonic aircraft operations generate sonic booms which may effect existing structures. Typical effects of the sonic boom range from a mild nuisance to damage to windows, plaster and bric-a-brac. A literature survey was performed to identify existing models, suitable for an environmental planner to use for assessing the impact of supersonic flights on conventional structures. A model developed by Hershey and Higgins was identified as the most nearly suitable model. As a result of an extensive sensitivity analysis of this model, a number of enhancements to the model were developed. Finally, the revised model was packaged to facilitate the use by an environmental planner. A comparison of the existing U.S. Air Force methodology and the mean damage estimates produced by the new approach shows that the existing method usually produces higher loss estimates, although sometimes the loss estimates are comparable. The new method offers the advantage of quantifying the degree of conservatism in damage estimates and extending it from window panes to include other vulnerable materials. GRA

N90-17179# Sandia National Labs., Albuquerque, NM.

CYCLIC DEFORMATION OF Sn-60 TO Pb-40 SOLDER JOINTS DURING THERMOMECHANICAL FATIGUE

Darrel R. Frear and Wendell B. Jones 1989 13 p Presented at the NPECOM '90 Meeting, Anaheim, CA, 26 Feb. - 1 Mar. 1990

(Contract DE-AC04-76DP-00789)

(DE90-004197; SAND-89-0720C; CONF-900271-1) Avail: NTIS HC A03/MF A01

Thermomechanical fatigue and isothermal fatigue tests were performed on Sn-60 to Pb-40 solder joints under a variety of strain ranges and rates. In isothermal fatigue deformation throughout the entire cycle occurs with the same mechanism. The mechanism at low temperatures is a dislocation process and at high temperatures it is a diffusional flow. In thermomechanical fatigue the deformation mechanism changes in each cycle from dislocation processes to diffusional flow which results in higher peak stresses at the high and low temperature portion of the cycle. This indicates that thermomechanical fatigue behavior can not be accurately predicted using isothermal fatigue. It was also found that decrease in strain rate slowed the heterogeneous coarsening process in thermomechanical fatigue. This is due to the fact that the dislocation substructure recovers more quickly than it work hardens which tends to minimize recrystallization and growth in the solder microstructure. DOE

N90-17180*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

COMPATIBILITY CONDITIONS OF STRUCTURAL MECHANICS FOR FINITE ELEMENT ANALYSIS

Surya N. Patnaik, Laszlo Berke, and Richard H. Gallagher (Clarkson Univ., Potsdam, NY.) Jan. 1990 35 p

(NASA-TM-102413; E-4966; NAS 1.15:102413) Avail: NTIS HC A03/MF A01 CSCL 20K

The equilibrium equations and the compatibility conditions are fundamental to the analyses of structures. However, anyone who undertakes even a cursory generic study of the compatibility conditions can discover, with little effort, that historically this facet of structural mechanics had not been adequately researched by the profession. Now the compatibility conditions (CC's) have been researched and are understood to a great extent. For finite element discretizations, the CC's are banded and can be divided into three distinct categories: (1) the interface CC's; (2) the cluster or field CC's; and (3) the external CC's. The generation of CC's requires the separating of a local region, then writing the deformation displacement relation (ddr) for the region, and finally, the eliminating of the displacements from the ddr. The procedure to generate all three types of CC's is presented and illustrated through examples of finite element models. The uniqueness of the CC's thus generated is shown. Author

N90-17181# AEDAR Corp., New Carrollton, MD.

TECHNIQUES FOR ANALYZING THE DYNAMIC RESPONSE OF STRUCTURAL SYSTEMS USING COMPUTER-DERIVED GREEN'S FUNCTIONS Final Technical Report, 1 May 1988 - 31 Jul. 1989

James A. Fabunmi 12 Sep. 1989 19 p

(Contract F49620-88-C-0060; AF Proj. 2302)

(AD-A214523; AEDAR-ATR-89-2; AFOSR-89-1288TR) Avail: NTIS HC A02/MF A01 CSCL 12/5

This research has focussed on the development of feasible approaches to the utilization of computer algebra to derive the Green's Function of interconnected structural systems. The key objectives of the effort were to develop MACSYMA-based routines for analyzing the Green's functions of structural systems consisting of uniform beams supported at discrete locations of linear springs and to extend these techniques to include attachments of linear spring-mass-damper substructures to uniform beams. Both of these objectives were met. The methodologies that were developed are summarized, including appendices which present the MACSYMA routines illustrating the application of these methodologies, as well as paper which was presented in Singapore at the International Noise and Vibration '89 Conference. GRA

N90-17182# Aeronautical Research Labs., Melbourne (Australia).

A SUMMARY OF THE BODNER-STOUFFER CONSTITUTIVE MODEL Aircraft Structures Technical Memorandum

N. Bridgford May 1989 23 p

(AD-A214532; ARL-STRUC-TM-513; DODA-AR-005-619) Avail: NTIS HC A02/MF A01 CSCL 11/6

Classical techniques of modelling creep and plasticity have a high degree of accuracy provided the inelastic strains are kept small. However, they are poor in describing material behavior where significant inelastic strains or unloading are involved. In a recent investigation, a number of unified constitutive models were examined. In these approaches, a single inelastic strain tensor is used to model both creep and plasticity. A new constitutive equation was then proposed. This new approach is described, and a FORTRAN program which uses these new equations to predict material behavior of high temperature superalloys is discussed.

Given either stress or stain values as input data, it evaluates the state variables, i.e., drag stress, back stress etc., the ineleastic strain rate and the inelastic work. GRA

N90-17183# Sandia National Labs., Albuquerque, NM.
THE 59TH SHOCK AND VIBRATION SYMPOSIUM, VOLUME 1
Henry C. Pusey, comp. and Sallie C. Pusey, comp. Oct. 1988 387 p Symposium held in Albuquerque, NM, 18-20 Oct. 1988; sponsored by DOD
(Contract DE-AC04-76DP-00789)
(AD-A214578; SAND-88-2473C-Vol-1; UC-13-Vol-1) Avail: NTIS HC A17/MF A02 CSCL 20/11

The proceedings of the 59th symposium are presented. Some of the areas of study are: An overview of Statistical Energy analysis; Data bases (The computerization of the DOE/DOD environmental data bank); A shock and vibration data base for military equipment and for aircraft; Vibroacoustic payload environment prediction system (VAPEPS); Vibroacoustic response using the finite element method and statistical energy analysis; Helium effect on spacecraft random vibration with VAPEPS program; Mechanical shock sensors (a feasibility study); and Mechanical impedance measurements using oblique excitation. Author

N90-17184# Sandia National Labs., Albuquerque, NM.
THE 59TH SHOCK AND VIBRATION SYMPOSIUM, VOLUME 4
Henry C. Pusey, comp. and Sallie C. Pusey, comp. Dec. 1988 292 p Symposium held in Albuquerque, NM, 18-20 Oct. 1988; sponsored by DOD
(Contract DE-AC04-76DP-00789)
(AD-A214581; SAND-88-2473C-Vol-4; UC-13-Vol-4) Avail: NTIS HC A13/MF A02 CSCL 20/11

The proceeding of the conference is presented. Some of the areas of discussion are: Validation testing of nuclear survivable systems; Vibroacoustic Payload Environment Prediction System (VAPEPS) (Using the VAPEPS program to support TOPEX spacecraft design); Statistical energy analysis modeling of nonstructural mass on lightweight equipment panels using VAPEPS, and stress estimation and statistical energy analysis of the Magellan spacecraft solar array using VAPEPS; Dynamic measurement (An automated vibration transducer calibration system using advanced FFT techniques); Dynamic criteria avionics environmental reliability; Modal applications -- Structural verification using modal frequency testing (A nondestructive evaluation); Model validation using substructure modal-testing applied to a large and very flexible wind turbine; and Analytical estimation of earth penetrator structural response and comparison with laboratory shock and modal test data; Shock -- Vertical launching system modeling techniques for shadow side effect during ship shock trials, and dynamic response of pipe subjected to high impact loads; Dynamic analysis -- Bubble jet calculations using the DYSMAS/E finite difference code, Convergence of finite element frequency analysis for a thin walled cylinder, and integral method for free edge plates with stiffeners; Vibration control -- Shock isolation using an active magnetostrictive element; and Prediction of modal characteristics and harmonic response of viscoelastically damped structures. GRA

N90-17185# Defence Research Establishment Atlantic, Dartmouth (Nova Scotia). Research and Development Branch.
A REVIEW OF THE THEORY AND METHODS FOR DETERMINING DYNAMIC PULSE BUCKLING OF CYLINDRICAL SHELLS
Neil G. Pegg Sep. 1989 88 p
(AD-A214764; DREA-TM-89/222) Avail: NTIS HC A05/MF A01 CSCL 20/11

A review of theoretical developments in predicting the buckling response of cylinders subject to impulsive loads is presented. Most of this theory deals with axisymmetric, radial impulses on cylinders. The development of solutions for the critical modes and loading magnitudes which produce excessive growth of displacements are reviewed. Existing theories cover the specific cases of either entirely elastic or entirely plastic material behavior for infinite length and short cylindrical shells. The resultant theories are applied to various shell geometries to investigate influential parameters. A review of numerical finite element and finite difference studies which investigate dynamic pulse buckling is also given. The requirements to examine dynamic buckling of more complex structures such as ring stiffened cylinders are discussed. Improvement in design to resist shock loads from hostile weapons or operational conditions has been the goal of considering dynamic buckling in the design of military structures such as missiles and rockets. This study presents a review of theoretical developments in dynamic pulse buckling to delineate the physical concepts of the process. This review serves as a basis for further work in developing an understanding of dynamic buckling in the context of submarine pressure hull response to underwater shock loading. GRA

N90-17186# Department of the Navy, Washington, DC.
STRUCTURAL VIBRATION AND SHOCK ISOLATION IN A HIGH PRESSURE ENVIRONMENT Patent Application
Ronald E. Waclawik, inventor (to Navy) 1 Jun. 1989 8 p
(AD-D014311; US-Patent-Appl-SN-359895) Avail: NTIS HC A02/MF A01 CSCL 13/11

At the output end of a piping system, components subject to vibration and shock are isolated from components at the input end of the system. The isolation is achieved by a clamping arrangement in which a plurality of deformable isolation material components are inserted between the two ends. The system operates under a high fluid pressure and is arranged to enable the high pressure to act upon the isolation material to assist in forming a seal within the flow path. GRA

N90-17187# Army Armament Research, Development and Engineering Center, Watervliet, NY.
ELASTIC-PLASTIC ANALYSIS OF A THICK-WALLED COMPOSITE TUBE SUBJECTED TO INTERNAL PRESSURE Final Report
Peter C. Chen Oct. 1989 21 p
(AD-A215258; ARCCB-TR-89027) Avail: NTIS HC A03/MF A01 CSCL 19/6

Organic composites have become familiar structural components in many applications that require high stiffness and low weight. A current problem in Army cannon design is to replace a portion of the steel wall thickness with an organic composite. The steel liner maintains the tube-projectile interface and shields the composite from the extremely hot gases. The steel also has elastic properties in the radial direction that are better than the composited for transferring loads. The theoretical and experimental results for an organic composite-jacketed steel tube subjected to internal pressure in the elastic range were described in a previous report. An elastic-plastic analysis is presented for a thick-walled composite tube subjected to internal pressure. The composite tube is constructed of a steel linear and a graphite-bismaleimide outer shell. Analytical expressions for stresses, strains, and displacements are derived for all cases where the structure is subjected to internal pressure. The loading ranges include elastic, elastic-plastic, and fully-plastic up to failure. Numerical results for the hoop strains in several composite tubes are presented. GRA

N90-17188# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction Scientifique de la Resistance des Structures.
PARAMETRIC VERSION OF STRUCTURAL VIBRATION MODELS Final Report [RECALAGE PARAMETRIQUE DE MODELES VIBRATOIRES DE STRUCTURES]
H. Berger, L. Barthe, and R. Ohayon Mar. 1989 50 p In FRENCH
(Contract DRET-88-34-001)
(ONERA-RT-9/3313-RY-080-R; ETN-90-96081) Avail: NTIS HC A03/MF A01

A repetitive structure is represented by an equivalent Timoshenko beam. The method is based on expressing the kinetic and potential energy of the elementary cell as a function of deformations of the beam type. The stiffness matrix is deduced for the equivalent beam. The results of the computations made by the finite element method are compared to those proposed by

the beam method either respecting the Kirchhoff hypothesis or not. It is shown that for few cells, the simplified beam method (not respecting Kirchhoff hypothesis) is enough. ESA

N90-17189 ESDU International Ltd., London (England).
CONSTRUCTION OF INELASTIC STRESS-STRAIN CURVES FROM MINIMAL MATERIALS DATA (COMPUTER PROGRAM) Abstract Only
Dec. 1989 25 p
(ESDU-89052; ISBN-0-85679-726-X; ISSN-0141-4089) Avail: ESDU

ESDU 89052 provides a FORTRAN program for computing the inelastic stress-strain curve, tangent and secant moduli, and the inelastic Poisson's ratio of a metallic material from limited commonly available materials properties. It requires values of the elastic modulus and two points in the inelastic region of the curve, and assumes that the curve can be represented by an equation containing the modulus of elasticity and two unknowns, a reference stress and a material characteristic. The method is valid for both tension and compression cases. The program input is explained, warnings provided when program limitations are infringed are set out and, through two worked examples, the output is illustrated. The program is available on magnetic media as ESDUpac 8952. ESDU

N90-17190 ESDU International Ltd., London (England).
BOUNDARY WALLS, FENCES AND HOARDINGS: MEAN AND PEAK WIND LOADS AND OVERTURNING MOMENTS Abstract Only
Dec. 1989 23 p Supersedes ESDU-70015 (in Wind Engineering only)
(ESDU-89050; ISBN-0-85679-724-3; ISSN-0143-2702; ESDU-70015) Avail: ESDU

ESDU 89050 gives graphical data for peak and area-averaged mean forces on panels in infinite walls, panels near the free end of a semi-infinite wall, panels near a right-angled corner, finite length walls, elevated panels and pairs of parallel walls. Peak design loads are obtained by using the peak forces in conjunction with the design hourly-mean wind speed. The data were derived from wind-tunnel test results extracted from the literature in which the typical variation of wind speed and turbulence with height was modelled. The correlation yielded a mean force that depended on the flow angle to the wall and the terrain upwind, and a peak fluctuating component that depended on the turbulence and the panel size in relation to the mean wind speed. Corresponding mean and peak overturning moments are estimated from the center of pressure position data given for each configuration. A step-by-step worked example illustrates the use of the correlation to estimate the forces on a typical wall. The basis for the analysis of the experimental data is explained. ESDU

N90-17191 ESDU International Ltd., London (England).
RESPONSE OF STRUCTURES TO ATMOSPHERIC TURBULENCE. RESPONSE TO ACROSS-WIND TURBULENCE COMPONENTS Abstract Only
Dec. 1989 52 p
(ESDU-89049; ISBN-0-85679-723-5; ISSN-0143-2702) Avail: ESDU

ESDU 89049 provides a step-by-step calculation method for estimating the loading and response, in both translational and torsional modes, due to the across-wind turbulence components. The loading is derived as the sum of a mean contribution together with background and resonant fluctuating contributions. The method uses precalculated loading factors and they are provided in both graphical and equation forms, based on the atmosphere model of the Sub-series, for the estimation of the fluctuating contributions. Worked examples illustrate the use of the method, which applies to vertical or horizontal structures (or structures normal to the wind but inclined across-wind), cantilevered or pinned at both ends or supported remote from a ground plane. ESDU

N90-17192 ESDU International Ltd., London (England).
ELASTIC STRESS CONCENTRATION FACTORS. GEOMETRIC DISCONTINUITIES IN RODS AND TUBES OF ISOTROPIC MATERIALS Abstract Only
Dec. 1989 24 p Supersedes ESDU-69021
(ESDU-89048; ISBN-0-85679-722-7; ISSN-0141-4089; ISSN-0958-0379; ISSN-0141-4097; ESDU-69021) Avail: ESDU

ESDU 89048 gives graphs of stress concentration factors plotted against appropriate geometric parameters. The data are for circumferential grooves of U- and wide or narrow flat-bottomed section in solid shafts and for diametral holes in solid or hollow shafts, with the shaft under axial loading, tension or torsion, and for fillets at stepped sections on solid or hollow shafts under axial loading or torsion. The data for the fillets and grooves have been extended to much lower radius/outside diameter ratios than those hitherto available by means of finite element analysis. ESDU

N90-17193 ESDU International Ltd., London (England).
FATIGUE OF ALUMINIUM ALLOY JOINTS WITH VARIOUS FASTENER SYSTEMS. LOW LOAD TRANSFER Abstract Only
Nov. 1989 35 p
(ESDU-89046; ISBN-0-85679-720-0; ISSN-0958-0379) Avail: ESDU

ESDU 89046 presents the results of over 900 axial load fatigue tests extracted from the literature on low load transfer joints under constant or variable amplitude loading. A low load transfer joint is one in which less than 10 percent of the axial load is transferred between the members and typically over half the joints in an airframe fall in this category, for example a skin-stiffener connection in a wing. Five different types of fastener are included, assembled with a range of fits from clearance to interference and with a variety of interfays. The data allows a choice to be made of the most appropriate system to improve fatigue strength under a given loading. Details of the alloys (7010-T7651, 2014-T651, 2024-T351, 2024-T3 clad or unclad, 7050-T76 or T7651 and 7475-7351) and of the test specimens are included and the influence of the various parameters on fatigue strength is discussed. Included are data for joints manufactured with a corner crack in the fastener hole; these tests were designed to investigate a repair in which the hole is drilled out but insufficiently to eliminate an existing crack. ESDU

N90-17194# Oak Ridge National Lab., TN. Applied Technology Div.
ANALYSIS OF COMPOSITE RING OF COMPRESSION TEST DATA
D. E. Welch Nov. 1989 117 p
(Contract DE-AC05-84OR-21400)
(DE90-004468; ORNL/ATD-24) Avail: NTIS HC A06

Results from IM6/ERL-2258 and S2 glass/ERL-2258 fiber composite ring compression tests using the Oak Ridge National Laboratory (ORNL) and the Wright Research and Development Center (WRDC) test methods are presented and analyzed. The WRDC test results indicate a strong dependence of apparent composite hoop strength with radius-to-thickness ratio for cross-plied constructions. This result may be due partially to classical circumferential buckling, because the reported radial pressures at failure for all of the S2 glass and one-half of the IM6 composite rings exceeded the critical radial pressures for circumferential buckling. However, this effect was not observed for the hoop-wound construction. The ORNL test results generally exhibited higher composite hoop stresses at failure than did the WRDC results, and all of the ORNL results exceeded the critical radial pressures for classical circumferential buckling. However, the higher ORNL results may be due to measuring strain rather than pressure on a significantly nonlinearly elastic material. In addition, both test results indicated that the composite hoop stress at failure was significantly higher for the S2 glass samples than for the IM6 samples. These results should be construed as upper limits of material strength attainable under hydrostatic loading conditions in the absence of buckling-dominated failure. DOE

N90-17195# Oak Ridge National Lab., TN. Engineering Technology Div.
HEAVY-SECTION STEEL TECHNOLOGY PROGRAM FRACTURE ISSUES
W. E. Pennell Oct. 1989 56 p Presented at the 17th Water Reactor Safety Information Meeting, Rockville, MD, 23-25 Oct. 1989
(Contract DE-AC05-84OR-21400)
(DE90-005264; CONF-8910222-1) Avail: NTIS HC A04/MF A01

Large scale fracture mechanics tests have resulted in the identification of a number of fracture technology issues. Identification of additional issues has come from the reactor vessel materials irradiation test program and from reactor operating experience. A review is provided of fracture issues with an emphasis on their potential impact on a reactor vessel pressurized thermal shock (PTS) analysis. Mixed mode crack propagation emerges as a major issue, due in large measure to the poor performance of existing models for the prediction of ductile tearing. Rectification of ductile tearing technology deficiencies may require extending the technology to include a more complete treatment of stress state and loading history effects. The effect of cladding on vessel fracture remains uncertain to the point that it is not possible to determine at this time if the net effect will be positive or negative. Enhanced fracture toughness for shallow flaws was demonstrated for low strength structural steels. Demonstration of a similar effect in reactor pressure vessel steels could have a significant beneficial effect on the probabilistic analysis of reactor vessel fracture. Further development of existing fracture mechanics models and concepts is required to meet the special requirements for fracture evaluation of circumferential flaws in the welds of ring forged vessels. Fracture technology advances required to address the issues discussed in this paper are the major objective for the ongoing Heavy Section Steel Technology (HSST) program at ORNL. DOE

42 GEOSCIENCES (GENERAL)

No abstracts in this category.

43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N90-17196# National Ocean Service, Rockville, MD. Office of Charting and Geodetic Services.
CHARTING AND GEODETIC SERVICES States' Activities Report, FY 1989 - FY 1990
Apr. 1989 355 p
(PB90-116674) Avail: NTIS HC A16/MF A02 CSCL 08B

The report is the latest in a series of similar reports of activities in the 50 states which began in 1980. It covers the activities of Charting and Geodetic Services (C and GS) of the National Ocean Service in FY 89 and 90. Activities that were undertaken in FY 88 and earlier also are included for historical reference. The report features separate descriptions of activities scheduled by C and GS program function. Each state's activities are listed separately and organized into five sections: ongoing and unique activities expected in FY 89, estimated funding for FY 90 and FY 90 by activity, significant past involvement in FY 88 and earlier, planned initiatives for FY 90, and specific issues of interest to the state. All states are then organized into regional geographic groups for ease of reference. Descriptions of C and GS activities in the islands and possessions of the United States are also presented in a separate section which follows the descriptions of activities in the 50 states. GRA

N90-17197*# Lockheed Engineering and Sciences Co., Houston, TX.
MISSION REPORT ON THE ORBITER CAMERA PAYLOAD SYSTEM (OCPS) LARGE FORMAT CAMERA (LFC) AND ATTITUDE REFERENCE SYSTEM (ARS)
Bernard H. Mollberg and Bruton B. Schardt Dec. 1988 341 p
(Contract NAS9-17900)
(NASA-CR-186273; JSC-23184; NAS 1.26:186273) Avail: NTIS HC A15/MF A02 CSCL 08B

The Orbiter Camera Payload System (OCPS) is an integrated photographic system which is carried into earth orbit as a payload in the Space Transportation System (STS) Orbiter vehicle's cargo bay. The major component of the OCPS is a Large Format Camera (LFC), a precision wide-angle cartographic instrument that is capable of producing high resolution stereo photography of great geometric fidelity in multiple base-to-height (B/H) ratios. A secondary, supporting system to the LFC is the Attitude Reference System (ARS), which is a dual lens Stellar Camera Array (SCA) and camera support structure. The SCA is a 70-mm film system which is rigidly mounted to the LFC lens support structure and which, through the simultaneous acquisition of two star fields with each earth-viewing LFC frame, makes it possible to determine precisely the pointing of the LFC optical axis with reference to the earth nadir point. Other components complete the current OCPS configuration as a high precision cartographic data acquisition system. The primary design objective for the OCPS was to maximize system performance characteristics while maintaining a high level of reliability compatible with Shuttle launch conditions and the on-orbit environment. The full-up OCPS configuration was launched on a highly successful maiden voyage aboard the STS Orbiter vehicle Challenger on October 5, 1984, as a major payload aboard mission STS 41-G. This report documents the system design, the ground testing, the flight configuration, and an analysis of the results obtained during the Challenger mission STS 41-G. Author

N90-17198# California Univ., Berkeley. Dept. of Materials Science and Mineral Engineering.
AIRBORNE ELECTROMAGNETIC SENSING OF SEA ICE THICKNESS Final Report
Alex Becker and Guimin Liu Dec. 1988 129 p
(Contract N00014-87-K-6005)
(AD-A214460) Avail: NTIS HC A07/MF A01 CSCL 08/12

A conventional frequency domain helicopter-borne electromagnetic (HEM) system can be used to map sea ice keels with a reasonable degree of accuracy. A preliminary interpretation of the acquired data can be made manually with the help of a nomogram or automated with the use of a table look-up routine on a small computer. Such data may also be more accurately interpreted with the use of an adaptation of Occam's inversion. This scheme allows for the practical non-uniqueness of the inverse solution but selects the smoothest keel shape that is consistent with the field data. The inversion method is much more computationally intensive than the table look-up technique. While the latter can be implemented on a small computer to form an interactive in-flight interpretation system, the inversion technique involves many forward computations and, for the present, is best reserved for past flight data analysis. It is possible that this difficulty can be resolved with the use of specialized computing equipment. In the strict sense both proposed interpretation techniques are only suitable for use on data acquired over two-dimensional features whose strike length (measured in a direction perpendicular to the flight line) is much greater than the flight height. Examination of the anomalies for three-dimensional keels however, reveals that good data interpretation is possible whenever the keel strike length exceeds the system height by a factor of three. GRA

N90-17199# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
ACTIVE AND PASSIVE REMOTE SENSING OF ICE Annual Report, 1 Oct. 1988 - 30 Sep. 1989
J. A. Kong 21 Nov. 1989 15 p
(Contract N00014-89-J-1107)
(AD-A214863) Avail: NTIS HC A03/MF A01 CSCL 20/14

Strong permittivity fluctuation theory is used to solve the problem of scattering from a medium composed of completely randomly oriented scatters under the low frequency limit. A multivariate K-distribution, well supported by experimental data, is proposed to model the statistics of fully polarimetric radar clutter of earth terrain. The 3-layer configuration is first reduced to 2-layers to observe fully polarimetric scattering directly from geophysical media such as snow, ice, and vegetation. The effects on polarimetric wave scattering due to the top layer are identified by comparing the 3-layer results with those obtained from the 2-layer configuration. The theory is used to investigate the effects on polarimetric radar returns due to a low loss and a lossy dry snow layers covering a sheet of thick first year sea ice. Polarimetric terrain backscattering data observed with satellite and airborne synthetic aperture radars (SAR) have demonstrated potential applications in geologic mapping and terrain cover classification. The 3-layer random medium model is developed for microwave remote sensing of snow covered sea ice. A radar clutter model is used to simulate fully polarimetric returns for a stepped frequency radar. The purpose is to create synthetic site dependent clutter signatures that can be utilized in a hardware-in-the-loop test system. Earth terrains are modeled by a 2-layer configuration to investigate the polarimetric scattering properties of the remotely sensed media. GRA

N90-17200# Massachusetts Inst. of Tech., Cambridge.
ENHANCED SATELLITE GEODESY THROUGH THE ADDITION OF A PSEUDORANGE OBSERVABLE M.S. Thesis
Jayant Sharma May 1989 55 p
(Contract F19628-86-K-0009)
(AD-A214987; GL-TR-89-0207; SR-4) Avail: NTIS HC A04/MF A01 CSCL 08/5

GPS satellites transmit suppressed carrier signals which are modulated by pseudorandom ranging codes known as Coarse/Acquisition (C/A) and Precise (P) codes. Range information can be derived by measuring the reconstructed carrier phase or delay of the code modulation of a received signal. Subcentimeter-level relative positioning was achieved by measuring carrier phase. Improvements in relative positioning were achieved by combining P code delay or pseudorange observations with phase observations. Since changes in the GPS will make P code observations impossible for civilian users, the effects are studied of combining C/A code observations with carrier phase observations. Carrier phase observations represent relatively precise, but biased, measurements of the satellite-to-receiver range. If phase observations are differenced between receivers and satellites, the bias is an integer number of cycles. If this integer value can be determined, position determination accuracy is improved. Range measurements based on code delay may help to determine integer bias. Unfortunately, the C/A code provides a relatively noisy range measurement. C/A code observations are simulated using actual phase observations. Mean values of ionospheric contributions to the simulated observations were determined from the international reference ionosphere model, and variations about the means were derived from actual dual-frequency phase observations. GRA

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

N90-17201# California Univ., Berkeley. Lawrence Berkeley Lab. Applied Science Div.
BIOMASS FUELS IN THE DEVELOPING COUNTRIES: AN OVERVIEW
Stephen Meyers and Gerald Leach (International Inst. for Environment and Development, London, England) Jul. 1989 56 p
(Contract DE-AC03-76SF-00098)
(DE90-002616; LBL-27222) Avail: NTIS HC A04/MF A01

An overview is presented of what is known about current patterns of biofuels supply and use in the developing countries. The diversity is illustrated of biofuels use, and how use changes with urbanization and commercialization of biofuels is discussed. Information is presented on sources of biofuels, the basic technologies employed for using biofuels is described along with the key factors involved in assessing change in biofuels use over time. Biofuels consumption data is presented from a number of surveys, and the main factors that shape the level of use of different biofuels is discussed. The responses of rural people to the increasing fuelwood scarcity that is occurring in many parts of the developing world are discussed. The transition is described from biofuels to modern fuels that occurs in cities, as are the factors that inhibit this transition. Estimates are presented of national biofuels consumption for 17 of the largest biofuels-using countries and for larger regions. The relationship between human use of biofuels and greenhouse gas emissions is discussed. Lastly, a discussion is presented of policies designed to affect biofuels supply and demand, describing the experience with and prospects for increasing biofuels supply, improving end-use efficiency, and encouraging the transition away from biofuels. DOE

N90-17202# New Energy and Industrial Technology Development Organization, Tokyo (Japan).
PATENTS ON SOLID ELECTROLYTE FUEL CELLS: JAPAN
Mar. 1989 347 p In JAPANESE
(DE90-702639; NEDOJ-P-8811-1) Avail: NTIS (US Sales Only) HC A15/MF A02

The purpose of the current investigation is to help the promotion and development of solid electrolyte fuel cells (SOFC) in Japan, which is now in the stage of elemental study, by investigating the trend and technological level of the Japanese technology in the SOFC field. As regards research and development for SOFC in Japan, studies and development have been carried on by the Electrotechnical Laboratory, the National Chemical Laboratory for Industry, and private industries led by the mentioned laboratories. Since the Electrotechnical Laboratory succeeded in 1.2 kW power generation with a cylinder type multi-cell structure system, the development activities have become very brisk. In America, Westinghouse Electric Corp. developed, in 1986, a cylinder type multi-cell 5 kW power generating system and has been performing field tests using a 3 kW system since October, 1987. In Europe, research and development have been carried on by Brown Boveri and Cie (BBC), Dornie, etc. SOFC has been very much expected for the application also to electric power generation. DOE

N90-17203# New Energy and Industrial Technology Development Organization, Tokyo (Japan).
PATENTS ON SOLID ELECTROLYTE FUEL CELLS: US AND BRITAIN
Mar. 1989 160 p In JAPANESE
(DE90-702640; NEDOJ-P-8811-2) Avail: NTIS (US Sales Only) HC A08/MF A01

The technological development trends and levels in the field

of solid electrolyte fuel cells in the U.S.A. and Britain are investigated. In America, Westinghouse Electric Corp. developed in 1986 a cylinder type multi-cell 5 kW power generating system, and has been performing field tests using a 3 kW system since October, 1987. In Europe, research and development have been carried on by Brown Boveri and Cie (BBC), Dornie, etc. In Japan, studies and development on SOFC have been carried on by the Electrotechnical Laboratory, the National Chemical Laboratory for Industry, and private industries led by the mentioned laboratories. The Electrotechnical Laboratory succeeded in 1.2 kW power generation with a cylinder type multi-cell structure system in March, 1987. SOFC has been very much expected for the application to electric power generation because of the availability of various kinds of fuel, high power generating efficiency, simple system configuration, and utilization of the generated high temperature exhaust heat to power generation. DOE

N90-17204# New Energy and Industrial Technology Development Organization, Tokyo (Japan).
PATENTS ON SOLID ELECTROLYTE FUEL CELLS: WEST GERMANY, NETHERLANDS AND SWEDEN
Mar. 1989 160 p In JAPANESE
(DE90-702641; NEDOJ-P-8811-3) Avail: NTIS (US Sales Only) HC A08/MF A01

The technological development trends and levels in the field of solid electrolyte fuel cells in West Germany, Netherlands and Sweden are investigated for the purpose of supporting the promotion and development of SOFC in Japan. In America, Westinghouse Electric Corp. developed in 1986 a cylinder type multi-cell 5 kW power generating system, and has been performing field tests using a 3 kW system since October, 1987. In Europe, research and development have been carried on by Brown Boveri and Cie (BBC), Dornie, etc. In Japan, studies and development on SOFC have been carried on by the Electrotechnical Laboratory, the National Chemical Laboratory for Industry, and private industries led by the mentioned laboratories. The Electrotechnical Laboratory succeeded in 1.2 kW power generation with a cylinder type multi-cell structure system in March, 1987. SOFC has been very much expected for the application to electric power generation because of the availability of various kinds of fuel, high power generating efficiency, simple system configuration, and utilization of the generated high temperature exhaust heat to power generation. DOE

N90-17205# Spire Corp., Bedford, MA.
LIGHT-TRAPPING CONCENTRATOR CELLS
Christopher J. Keavney, Leo M. Geoffroy, Michael M. Sanfacon, and Stephen P. Tobin Nov. 1989 87 p
(Contracts DE-AC04-76DP-00789; SNL-02-7063E)
(DE90-004988; SAND-89-7092) Avail: NTIS HC A05/MF A01

The objective was to develop a thin, light-trapping silicon concentrator solar cell using a new structure, the cross-grooved cell. A process was developed for fabricating V-grooves on both sides of thin silicon wafers, the grooves on one side being perpendicular to those on the other side. A way to minimize flat spots at the tops of the V-grooves was discovered. The theoretical light-trapping superiority of the cross-grooved structure was verified. A reduction was also demonstrated in grid line obscuration for grid lines running parallel to the V-grooves due to light reflection into the cell. High short-circuit current densities were achieved for p-i-n concentrator cells with the cross-grooved structure, proving the concept. The best efficiencies achieved were 18 percent at concentration, compared to 20 percent for a conventional planar low-resistivity cell. Recombination in the full-area emitter was identified as the major intrinsic loss mechanism in these thin, high-resistivity bifacial cells. Recombination on the emitter limits Voc and fill factor, and also leads to a large sublinearity of short-circuit current with light intensity. Reduction of the junction area is a major recommendation for future work. In addition, there were persistent problems with ohmic contacts and maintaining high minority-carrier lifetime during processing. It is believed that these problems can be solved, and that the cross-grooved cell is a viable approach to the limit-efficiency silicon solar cell. This report covers research conducted between March 1987 and July 1989. DOE

N90-17206# Environmental Protection Agency, Ann Arbor, MI. Control Technology and Applications Branch.
OVERVIEW OF PHOTOVOLTAIC AND BATTERY APPLICATIONS
J. D. Murrell and Karl H. Hellman Oct. 1989 14 p
(PB90-120536; EPA/AA/CTAB-89/07) Avail: NTIS HC A03/MF A01 CSCL 10B

The use of solar cells and batteries for power generation and vehicle propulsion is examined. Issues such as energy uses and fuel sources, solar electric power, energy storage for solar photovoltaic systems, batteries for electric cars and applications for other mobile sources are also discussed. Author

N90-17207# International Solar Electric Technology, Inglewood, CA.
HIGH-EFFICIENCY COPPER TERNARY THIN FILM SOLAR CELLS Annual Technical Progress Report, 1 Mar. 1987 - 30 Apr. 1989
V. K. Kapur, B. M. Basol, and R. C. Kullberg Sep. 1989 44 p
(Contracts DE-AC02-83CH-10093; XL-7-06031-6)
(DE89-009470; SERI/STR-211-3574) Avail: NTIS HC A03/MF A01

A project is described which developes a high efficiency thin film CuInSe2 solar cell using a low-cost process. The two-stage process involves depositing the metallic elements of Cu and In on a substrate in the form of stacked layers, and then selenizing this stacked metallic film in an atmosphere containing Se. Early research concentrated on the electrodeposition technique for depositing the Cu and In films on Mo-coated glass substrates. This resulted in small-area cells with around 10 percent efficiency, indicating that the technique could yield CuInSe2 films with good electrical and optical properties. The program then involved scaling up the electrodeposition/selenization technique; fixtures for large-area plating were designed and built, but poor adhesion of the CuInSe2 films to the Mo-coated substrates and the stoichiometric non-uniformities encountered in the large-area films hindered the efficiency of the devices. The latter part of the program explored a new approach to the two-stage process. An evaporation/selenization approach, where the elemental layers were evaporated onto the Mo-coated substrates for selenization. Solar cells were produced with efficiencies approaching 11 percent using E-beam evaporated/selenized CuInSe2 films. DOE

N90-17208# Solarex Corp., Newtown, PA. Thin Film Div.
RESEARCH ON STABLE HIGH-EFFICIENCY, LARGE AREA, AMORPHOUS SILICON-BASED SOLAR CELLS, PHASE 2 Annual Subcontract Report, 1 Feb. 1988 - 1 Feb. 1989
A. W. Catalano, R. R. Ayra, M. S. Bennett, C. R. Dickson, B. Fieselmann, B. Goldstein, J. Morris, E. Twesme, J. G. ODowd, and R. S. Oswald et al Oct. 1989 103 p
(Contracts DE-AC02-83CH-10093; ZB-7-06003-2)
(DE89-009491; SERI/STR-211-3580-Phase-2) Avail: NTIS HC A06

Photovoltaic research conducted in four areas is described: semiconductor materials, high-efficiency cells, nonsemiconductor materials, and submodules. The major focus of semiconductor materials research was on improving the quality of wide-band-gap a-SiC:H alloys and narrow-band-gap a-SiGe:H alloys. Raman spectroscopy suggested that the alloys are inhomogeneous, showing a higher concentration of Ge-Ge bonds than expected from a random mixing model. In high-efficiency device research, silicon-carbon single-junction cells resulted in open-circuit voltages as high as 0.96 V with a higher than 0.6 fill factor. Silicon-germanium cells show far better performance using a p/i-graded interface, an i(a-Si)/i(a-SiGe)-graded interface, and an inverse-graded interface at the i/n junction along with an a-Si n-layer compared with an a-SiGe:H n-layer. In the nonsemiconductor materials research, modeling optical enhancement of long-wavelength light in single-junction cells suggested that several parasitic losses are

present in the device structure. In most cases, absorption in the rear contact is the major loss mechanism. In submodule research, the focus was on developing high-efficiency a-Si:H single-junction modules, stable a-Si:H stacked-junction modules, high-efficiency alloy-stacked modules, and advanced laser scribing processes.
DOE

N90-17209# Chronar Corp., Princeton, NJ.
RESEARCH ON AMORPHOUS SILICON BASED THIN FILM PHOTOVOLTAIC DEVICES. PHASE 2: RESEARCH ON STABLE HIGH-EFFICIENCY, LARGE AREA AMORPHOUS SILICON BASED SUBMODULES Annual Technical Progress Report, 16 Mar. 1988 - 15 Mar. 1989
A. E. Delahoy, F. B. Ellis, Jr., F. J. Kampas, T. Tonon, and H. A. Weakliem Dec. 1989 53 p
(Contracts DE-AC02-83CH-10093; ZB-7-06003-1)
(DE89-009515; SERI/STR-211-3609-Phase-2) Avail: NTIS HC A04/MF A01

A project is described which developes amorphous silicon p-i-n/p-i-n tandem junction photovoltaic submodules with an aperture-area efficiency of at least 9 percent. A second objective was to demonstrate 8 percent-efficient tandem submodules that degrade by no more than 5 percent under standard light-soaking conditions. Improved deposition conditions were established for tandem cells; the resulting efficiencies were nearly as high as those for single-junction cells. An amorphous silicon tandem cell (1 ft sq) was fabricated with an aperture-area efficiency of 7.2 percent. Also, good outdoor stability was observed for a glass-encapsulated tandem submodule. Also produced (by magnetron sputtering) were high-quality doped zinc-oxide films (5 ohms/square).
DOE

N90-17210# Energy Research Corp., Danbury, CT.
DETERMINATION OF OPTIMUM ELECTROLYTE COMPOSITION FOR MOLTEN CARBONATE FUEL CELLS Final Report
C. Y. Yuh and A. Pigeaud Jun. 1989 111 p
(Contract DE-AC21-86MC-23264)
(DE90-000410; DOE/MC-23264/2756) Avail: NTIS HC A06/MF A01

The Molten Carbonate Fuel Cell (MCFC) is a promising option for highly efficient generation of electricity. The overall objective of this study was to optimize the composition of the presently used alkali carbonate electrolyte by modifying important fuel cell performance and endurance-related properties. A short list of carbonate melt characteristics affected by changes in alkali composition includes: ionic conductivity, vapor pressure and melting range, gas and electrode solubilities, materials corrosion and matrix stability effects, as well as surface tension, diffusion and electrokinetic effects. The study focused primarily on out-of-cell corrosion, solubility and stability of components, and electrode kinetic and wetting effects of the various candidate electrolyte compositions selected for screening. Finally, bench-scale 300 sq cm fuel cell tests were operated, lasting from 1000 hours up to 5000 hours to confirm the general conclusions reached from the literature data and out-of-cell experiments. Overall, the major accomplishment of this study has been to show that significant improvements in fuel cell operation may be obtained by employing the eutectic lithium/sodium carbonate composition as the MCFC electrolyte.
DOE

N90-17211# Pacific Northwest Lab., Richland, WA.
A NEW METHOD FOR POWER GENERATION AND DISTRIBUTION IN OUTER SPACE
Judith Ann Bamberger Sep. 1989 7 p Presented at the 7th Symposium on Space Nuclear Power Systems, Albuquerque, NM, 7-11 Jan. 1990
(Contract DE-AC06-76RL-01830)
(DE90-005571; PNL-SA-17434; CONF-900109-19) Avail: NTIS HC A02/MF A01

The power system is a major component of a space system's size, mass, technical complexity, and hence, cost. To date, space systems include the energy source as an integral part of the mission satellite. Potentially significant benefit could be realized by separating the energy source from the end-use system and transmitting the power via an energy beam (power beaming) (Coomes et al., 1989). This concept parallels the terrestrial central generating station and transmission grid. In this summary, the system components required for power beaming implementation are outlined and applied to a satellite constellation to demonstrate the feasibility of implementing power beaming in the next 20 years.
DOE

45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

N90-17212 State Univ. of New York, Stony Brook.
TIME AND SPATIALLY DEPENDENT ESTIMATES OF POLLUTANT TRACE GAS EMISSIONS AND THEIR EFFECT ON TROPOSPHERIC OZONE Ph.D. Thesis
Jane Elizabeth Dignon 1988 196 p
Avail: Univ. Microfilms Order No. DA8921215

Statistical models have been developed to relate the rate of pollutant emissions from fossil fuel combustion to the rate of fuel consumption. These models have been used to estimate global emissions of nitrogen and sulfur oxides in fossil fuel combustion since the year 1860. When averaged over the 1860 to 1980 period, global sulfur emissions increased at a rate of 2.9 percent per year, and the nitrogen emissions increased a rate of 3.4 percent per year. Using these statistical models along with population distribution estimates, high resolution geographical maps of emissions can be produced for each year in which fuel consumption data are available. Global emissions of NO sub x and SO sub x emissions for 1966 and 1980 are illustrated on a latitude-longitude grid appropriate for general circulation models of the atmosphere. Emissions of carbon monoxide from fossil fuel, wood and biomass fuel, and open burning of vegetation, as well as emissions of nitrogen and sulfur oxides from wood and biomass fuel burning, are estimated for 1980 using emission factor methods. These trace gas sources are also mapped globally. The impact of increasing emission of NO sub x on tropospheric ozone abundance is estimated by calculations with a one-dimensional (latitudinal) model which includes coupled tropospheric photo-chemistry and diffusive meridional transport.
Dissert. Abstr.

N90-17213 Yale Univ., New Haven, CT.
DISPELLING THE NORTH AMERICAN ACID RAIN CLOUDS: DEVELOPING A FRAMEWORK FOR POLITICAL CONSENSUS THROUGH THE IDENTIFICATION OF ELITE VIEWPOINTS, VOLUMES 1 AND 2 Ph.D. Thesis
Neeloo Bhatti 1988 876 p
Avail: Univ. Microfilms Order No. DA8917143

Distinctive opposing viewpoints regarding the acidic deposition are characterized. In addition, the specific areas of consensus and disagreement among these elite groups were determined. All of these objectives were carried out using the results of the Q-sort technique and interviews with members of the acid rain elite in both Canada and the United States (i.e., politicians, scientists, regulators, environmental/advocacy groups, and industry/utility personnel). Furthermore, as an understanding of the entire acidic deposition phenomenon is necessary for its political resolution, a comprehensive, in-depth review of the scientific, legal, economic, social and political aspects of this issue was conducted. The results of this study revealed the existence of five main viewpoints (with three subgroups in viewpoint I) and indicated that most of the respondents relied more on non-scientific factors than scientific ones in shaping their viewpoints. The results also showed that there was direct opposition only between two of the viewpoints but, overall, the viewpoints were orthogonal to each other. There were also three compromising groups who were positively correlated with all the viewpoints and the opinions of these were used to formulate a general acidic deposition policy program that

would be acceptable to the largest number of elites.
Dissert. Abstr.

N90-17214# Illinois Univ., Urbana-Champaign. Inst. for Environmental Studies.
MEASURING THE DEMAND FOR ENVIRONMENTAL STUDIES Final Report
John B. Braden and Charles D. Kolstad Jul. 1989 375 p Sponsored by Illinois Dept. of Energy and Natural Resources, Springfield and Illinois Agricultural Experiment Station
(PB90-100207; IL/ENR/RE/EA-89/18) Avail: NTIS HC A16/MF A02 CSCL 13B

A review is presented of the state-of-the-art of measuring the demand for environmental goods and services. Three chapters are concerned with the theory of constructed markets, household production and hedonics. Applied chapters cover health effects, aesthetics, recreation, non-use benefits and materials damage. The report is intended to be a definitive reference on the subject of estimating the value of changes in environmental quality. Each chapter is an advanced instructional resource that brings the reader from first principles to the state-of-the-art. The emphasis is on principles that guide the use of analytical methods. Since no two studies of the value of environmental services are the same, there is no pretext of trying to determine a specific measure of the value of health effects, for example, that could be applied in a range of circumstances. Specific applications and numerical estimates are used only to illustrate issues, not to define or resolve them. The aim is to equip present and future analysts and those interested in research opportunities in this field to study the difficult issues that obscure the economic value to environmental goods and services. Author

N90-17215# Argonne National Lab., IL.
A COLLABORATIVE EFFORT TO MODEL PLANT RESPONSE TO ACIDIC RAIN
J. Jacobson, P. Irving, A. Kuja, J. Lee, D. Shriner, J. Troiano, S. Perrigan (Oregon State Univ., Corvallis.), and V. Cullinan 1989 28 p
(Contract W-31-109-eng-38)
(DE90-003002; ANL/PPRNT-89-183) Avail: NTIS HC A03/MF A01

Radish plants were exposed three times per week to simulated acidic rain at pH values of 2.6 to 5.4 over the course of four weeks in trials performed at Argonne, Illinois; Ithaca and Upton, New York; Corvallis, Oregon; Oak Ridge, Tennessee; and Toronto, Canada. Uniform genotype, soil media and planting techniques, treatment procedures, biological measurements, and experimental design were employed. Growth of plants differed among trials as a result of variation in greenhouse environmental conditions according to location and facilities. Larger plants underwent greater absolute but lower relative reductions in biomass after exposure to the higher levels of acidity. A generalized Mitscherlich function was used to model the effects of acidity of simulated rain on dry mass of hypocotyls using data from three laboratories that performed duplicate trials. The remaining data, from three other laboratories that performed only one trial each, were used to test the model. DOE

N90-17216*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ENVIRONMENTAL PROJECTS. VOLUME 9: CONSTRUCTION OF HAZARDOUS MATERIALS STORAGE FACILITIES
15 Nov. 1989 75 p
(Contract NAS7-918)
(NASA-CR-186296; NAS 1.26:186296; JPL-Publ-87-4-Vol-9)
Avail: NTIS HC A04/MF A01 CSCL 13B

Activities at the Goldstone Deep Space Communications Complex (GDSCC) are carried out in support of seven parabolic dish antennas. These activities may give rise to environmental hazards. This report is one in a series of reports describing environmental projects at GDSCC. The construction of two hazardous materials and wastes storage facilities and an acid-wash facility is described. An overview of the Goldstone complex is also presented along with a description of the environmental aspects of the GDSCC site. Author

N90-17217# Institute of Applied Energy, Tokyo (Japan).
PROSPECT OF NEW ENERGY. GLOBAL WARMING (1988)
Feb. 1988 28 p In JAPANESE
(DE90-702486; TIAE-8901) Avail: NTIS (US Sales Only) HC A03/MF A01

New energy has been developed mainly as substitutes for oil. The issue on global warming by carbon dioxide is considered as one of new energy development strategy. Carbon ranges over the atmosphere, the ocean, and woodlands, and there is the great global sized carbon cycle. The emission of carbon dioxide in the air has increased year by year mainly because of the combustion of fossil fuels, and the Earth's temperature has been raised by the greenhouse effect. It is feared that this temperature change affects the farm products and raises the surface of the sea water. Thinkable countermeasures to global warming are to reduce the emission of carbon dioxide, to catch it before or after emitted in the air, and to adapt it as an unavoidable situation. Since the global warming issue is possible to influence human society and nature seriously, it is necessary to be processed with international cooperation in the early states. DOE

N90-17218# Houston Univ., TX. Dept. of Chemistry.
REACTIONS OF ATMOSPHERIC SPECIES WITH CLEAN AND H, C, AND O IMPLANTED SPECIES Final Report, 1 Apr. 1986 - 15 Jul. 1989
J. W. Rabalais 27 Jul. 1989 131 p
(Contract F19628-86-K-0013)
(AD-A214602; GL-TR-89-0243) Avail: NTIS HC A07/MF A01 CSCL 20/5

The interactions of low energy ions with surfaces have been studied using surface science techniques. The energy range studied is from about 1 eV to 5 keV; the ions involved are rate gas ions (He+, Ne+, Ar+) and reactive ions such as N+2, N+, C+, CO+, and O+, and the surfaces included compounds such as K2TiF6, K2NbF7, K2TaF7, and boron nitride (BN) and elemental materials such as graphite, gold, magnesium, nickel, boron, Si(100), and W(211). The phenomena investigated included scattering, recoiling, ion induced surface damage (decomposition, oxidation, nitridation, chemisorption), inelastic collisions with emission of photons and electrons, scattered and recoiled ion fractions, collisional dissociation, and the dynamics of low energy collisions. The results are contained in six scientific publications in refereed journals. GRA

N90-17219# Institut Franco-Allemand de Recherches, Saint-Louis (France).
EVALUATING CO, CO2 AND H2O CONCENTRATION BY PARTIAL INTEGRATION OF ABSORPTION BAND SPECTRA [KONZENTRATIONSBESTIMMUNG VON CO, CO2 UND H2O DURCH TEILINTEGRIERTE BANDENABSORPTION]
H. Mach 27 Jun. 1988 29 p In GERMAN
(ISL-R-110/88; ETN-90-96100) Avail: NTIS HC A03/MF A01

Infrared absorption coefficients are used to determine the relative concentrations of CO, CO2 and H2O. A tunable infrared diode laser is used to carry out these measurements. Applications of this concentration measuring technique to the analysis of secondary combustion in rocket engines is discussed. ESA

N90-17220# Sandia National Labs., Albuquerque, NM. Strategic Technologies Div.
THE POTENTIAL IMPACT OF CONSERVATION, ALTERNATIVE ENERGY SOURCES, AND REDUCED NONENERGY EMISSIONS ON GLOBAL WARMING
Eugene A. Aronson and Michael W. Edenburn Dec. 1989 75 p
(Contract DE-AC04-76DP-00789)
(DE90-004494; SAND-89-1380) Avail: NTIS HC A04/MF A01

Two global energy consumption scenarios and corresponding nonenergy scenarios are examined to determine how each will contribute to the greenhouse effect and global warming. A steady

emissions trend scenario assumes only modest energy conservation and little change in the world's energy consumption patterns and nonenergy emissions. A reduced emissions trend scenario assumes significant conservation, switching from a more carbon-intensive energy source mix to a less intensive mix, and reducing nonenergy emissions. Based on the difference between the two scenarios' results, it is concluded that it is possible to reduce global warming by over 50 percent using a combination of conservation and efficiency improvements; increased use of nuclear; geothermal, and solar/renewable energy sources; and reduced nonenergy emissions. DOE

N90-17221# Oak Ridge National Lab., TN.
ENVIRONMENTAL IMPACT STATEMENT ON THE US ANTARCTIC PROGRAM Foreign Trip Report
Robert M. Reed, Steven F. Railsback, and Richard B. McLean 22 Dec. 1989 13 p
(Contract DE-AC05-84OR-21400)
(DE90-004940; ORNL/FTR-3497) Avail: NTIS HC A03/MF A01

Three staff members from Oak Ridge National Laboratory (ORNL) participated in a site visit to US Antarctic Program (USAP) facilities at McMurdo Station, Amundsen-Scott South Pole Station, and remote field and support sites. Interviews were conducted with National Science Foundation, Navy, and ITT/Antarctic Services staff responsible for environmental management functions. The ORNL team visited all facilities at McMurdo Station, three remote field camps, a Navy refueling facility, South Pole Station, and Scott Base (a New Zealand installation). In general, the team found that environmental impacts of the USAP are minor for the Antarctic continent as a whole. Improvements for the handling and disposal of solid wastes and the discharge of wastewaters that have been initiated should help minimize environmental impacts of USAP activities. The information collected during the site visit will be used in a draft supplemental environmental impact statement on the USAP to be published for public review in June 1990. DOE

N90-17222# Pacific Northwest Lab., Richland, WA.
THE USE OF COMPUTER PROGRAMS TO DETERMINE ENVIRONMENTAL COMPLIANCE, PREDICT PERFORMANCE, AND ASSESS IMPACTS
K. A. Higley and R. A. Geiger (Department of Energy, Washington, DC.) Nov. 1989 9 p Presented at the 28th Hanford Life Sciences Symposium on Environmental Monitoring, Restoration and Assessment: What Have We Learned, Richland, WA, 16-19 Oct. 1989
(Contract DE-AC06-76RL-01830)
(DE90-005230; PNL-SA-16971; CONF-891053-16) Avail: NTIS HC A02/MF A01

Mathematical models (and their computerized analogs) are widely used in the environmental field to answer questions that cannot easily be addressed by other means. Environment-focused computer programs were developed for a variety of purposes. The programs are used to predict the long-term performance of repositories, estimate the acute impacts from accidental releases of hazardous materials, demonstrate compliance with federal regulations, and evaluate the effects of routine releases of materials into the environment. The willingness and, in many instances, need to rely solely on these computer programs for answers place us in a potentially vulnerable position. The steps which should be taken to ensure the accuracy and reasonableness of the computer program-derived assessments are examined. Criteria are suggested for the development, selection, and use of environmental models as implemented in computer programs. A comparison of these criteria will be made for two situations: their use to demonstrate regulatory compliance with the radionuclide emission standards of 40 CFR Part 61; and their use as scientific tools to evaluate the effects of routine releases of radioactive materials into the environment. Validation, verification, calibration, and quality assurance will be addressed in light of the specific program applications. DOE

N90-17223# Oak Ridge National Lab., TN. Office of Risk Analysis.
EVALUATION OF THE USE OF FLAT TERRAIN MODELS VERSUS COMPLEX TERRAIN SCREENING MODELS IN ESTIMATING POLLUTANT TRANSPORT AND DEPOSITION IN COMPLEX TERRAIN
Mark W. Yambert, Greg D. Belcher, and Curtis C. Travis Dec. 1989 27 p Presented at the US EPA/ORNL Workshop on Municipal Waste Combustion: Deposition, Food Chain Impacts, Uncertainty, and Research Needs, Cincinnati, OH, 8-9 Jun. 1989
(Contract DE-AC05-84OR-21400)
(DE90-005271; CONF-8906180-5) Avail: NTIS HC A03/MF A01

A study was performed to determine the validity of using the flat terrain, Gaussian plume Industrial Source Complex Short Term and Industrial Source Complex Long Term models for modeling sources in complex terrain and to ascertain whether deposition rates estimated could be improved upon through the use of advanced, particle size- dependent deposition models. DOE

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N90-17224 California Univ., Davis.
PARTICLE RESUSPENSION AND ASSOCIATED COHERENT STRUCTURES IN A TURBULENT BOUNDARY LAYER Ph.D. Thesis
David Alan Braaten 1988 183 p
Avail: Univ. Microfilms Order No. DA8910493

Fundamental properties of particle resuspension from a surface solely by turbulent fluid forces was examined experimentally by observing intermittent particle resuspension and associated turbulent flow properties. Experiments were conducted in an environmental wind tunnel, where sparse beds of monodisperse Lycopodium spores (Club Moss) were placed flush with the floor of the wind tunnel, and exposed to a steady, well developed turbulent boundary layer flow. Particle bed concentration was monitored in situ throughout each experimental trial using an optical system designed to detect forward scattering from a HeNe laser beam. Simultaneous measurements of streamwise and vertical velocity were made immediately downstream of the illuminated particles using hot film anemometry. Experimental trials were conducted at three free-stream velocities (6.0, 7.5, and 9.0 m s(-1)) for a duration of 35 minutes. A Monte-Carlo particle resuspension model was developed to simulate the resuspension process associated with coherent structures of varying magnitude. Simulations were compared with experimental results to identify a probability distribution of coherent structure magnitude.

Dissert. Abstr.

N90-17225 State Univ. of New York, Albany.
A NUMERICAL STUDY OF THE FORMATION OF MESOSCALE CONVECTIVE COMPLEXES Ph.D. Thesis
Michael P. Dudek 1989 284 p
Avail: Univ. Microfilms Order No. DA8910707

The formation of two mesoscale convective complexes was investigated using a three-dimensional nested grid numerical model with real-data initial states. The model included a deep convective parameterization which incorporates the thermodynamic effects of downdrafts, a representation of non-precipitating cumulus clouds and a high resolution boundary layer with horizontally varying surface characteristics. Two MCC's were simulated, the first on 12-13 August 1982 and the second on 19-20 June 1983. The 24 hour control experiments simulated the development of conditions in which strong persistent convection could form within the MCC genesis region. In each case the initial convection associated with the MCC was triggered by a mesoscale region of lower tropospheric upward motion. The diabatic heating from this convection produced

a deep layer of strong ascent. Large scale regions of low inertial stability near the tropopause over each MCC may have enhanced the overall convection by reducing the local compensating subsidence near the developing mesoscale system. Numerical sensitivity experiments showed that the shallow non-precipitating cumulus clouds which occur within a daytime boundary layer over land can significantly modify the regional pre-convective thermodyamic environment by producing a partially mixed layer above the well mixed boundary layer. Experiments using only explicit grid-scale condensational heating illustrated the necessity of a convective parameterization to simulate the formation of an MCC in a meso-alpha scale model. Dissert. Abstr.

N90-17226 California Univ., Los Angeles.
NUMERICAL MODELING OF THE ATMOSPHERE WITH AN ISENTROPIC VERTICAL COORDINATE Ph.D. Thesis
Yueh-Jiuan Hsu 1988 185 p
Avail: Univ. Microfilms Order No. DA8906118

The purpose is to develop a numerical model of the atmosphere using an isentropic vertical coordinate and to demonstrate the usefulness of such a model in simulating basic dynamical processes in the atmosphere, particularly those associated with the nonlinear evolution of baroclinic waves, generation of upper-tropospheric fronts, and troposphere-stratosphere interactions. In the model, some important integral constraints are maintained in the vertical discretization. In treating the intersections of the coordinate surfaces with the lower boundary, researchers followed the massless-layer approach, in which the intersecting coordinate surfaces are extended along the lower boundary by introducing massless layers. Although this approach formally eliminates the intersection problem, it raises two other problems. First, computational generation of negative mass can occur. Moreover, dispersion errors can be serious near the boundaries of the massless and finite-mass regions. Second, infinite potential vorticities in the massless region can easily contaminate the finite-mass region. Researchers constructed a positive-definite advection scheme for the continuity equation, which is not only free from negative mass generation but also free from large dispersion errors. They also developed a family of schemes for the shallow-water momentum equation in which potential enstrophy can decrease while energy is conserved for the case of nondivergent mass flux. Dissert. Abstr.

N90-17227*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
NIMBUS 7 SOLAR BACKSCATTER ULTRAVIOLET (SBUV) OZONE PRODUCTS USER'S GUIDE
Albert J. Fleig, R. D. McPeters, P. K. Bhartia, Barry M. Schlesinger, Richard P. Cebula, K. F. Klenk, Steven L. Taylor (ST Systems Corp., Lanham, MD.), and Donald F. Heath Jan. 1990 117 p
(Contract NAS5-29386)
(NASA-RP-1234; Rept-636; NAS 1.61:1234) Avail: NTIS HC A06/MF A01 CSCL 04A

Three ozone tape products from the Solar Backscatter Ultraviolet (SBUV) experiment aboard Nimbus 7 were archived at the National Space Science Data Center. The experiment measures the fraction of incoming radiation backscattered by the Earth's atmosphere at 12 wavelengths. In-flight measurements were used to monitor changes in the instrument sensitivity. Total column ozone is derived by comparing the measurements with calculations of what would be measured for different total ozone amounts. The altitude distribution is retrieved using an optimum statistical technique for the inversion. The estimated initial error in the absolute scale for total ozone is 2 percent, with a 3 percent drift over 8 years. The profile error depends on latitude and height, smallest at 3 to 10 mbar; the drift increases with increasing altitude. Three tape products are described. The High Density SBUV (HDSBUV) tape contains the final derived products - the total ozone and the vertical ozone profile - as well as much detailed diagnostic information generated during the retrieval process. The Compressed Ozone (CPOZ) tape contains only that subset of HDSBUV information, including total ozone and ozone profiles, considered most useful for scientific studies. The Zonal Means Tape (ZMT) contains daily, weekly, monthly and quarterly averages of the derived quantities over 10 deg latitude zones. Author

N90-17228# International Centre for Theoretical Physics, Trieste (Italy).
DISTRIBUTION AND SEASONAL VARIATIONS OF DIFFUSE FRACTION
K. Anane-Fenin (Liberia Univ., Monrovia.) Jun. 1989 23 p
Submitted for publication
(DE90-601303; IC-89/143) Avail: NTIS (US Sales Only) HC A03/MF A01

A moving average approach is used to develop linear and polynomial regression models for the diffuse fraction averaged over 10, 15, 20 and 30 days. The correlations do not appear to be influenced by climate conditions or altitude. It is noted that the correlations vary with season. The time-dependent variations of the diffuse fraction correlations are examined by studying the residual differences between the measured diffuse fraction and those calculated from the over-all best-fit correlation. The residuals exhibit no pronounced pattern leading to the conclusion that the observed seasonal variation is caused by air mass and water vapour and that atmospheric turbidity plays little or no part. DOE

N90-17229*# Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric, and Planetary Sciences.
TECTONIC HISTORY OF THE TERRESTRIAL PLANETS Final Technical Report, 1 Oct. 1976 - 30 Sep. 1989
Sean C. Solomon 2 Feb. 1990 13 p
(Grant NsG-7297)
(NASA-CR-186309; NAS 1.26:186309) Avail: NTIS HC A01/MF A01 CSCL 08G

It is impossible in a single brief summary to convey the full range of research results that have come from this project over the last 13 years. The sweep of subjects covered ranges widely over the broad areas of the thermal and tectonic evolution of the terrestrial planets. A full list of all publications supported by this grant is presented. The list includes 48 published journal articles, 2 papers currently in press, 3 chapters of books, 4 M.I.T. theses, 1 technical report, and 107 published abstracts and extended abstracts. All of these publications were submitted separately to NASA at the time of publication or submission. Author

N90-17230# Ohio State Univ., Columbus. Dept. of Geodetic Science and Surveying.
DETERMINATION OF THE GRAVITY DISTURBANCE ON THE EARTH'S TOPOGRAPHIC SURFACE FROM AIRBORNE GRAVITY GRADIENT DATA
Yan M. Wang Dec. 1988 52 p
(Contract F19628-86-K-0016)
(AD-A214596; OSU/DGSS-401; GL-TR-89-0173; SR-7) Avail: NTIS HC A04/MF A01 CSCL 08/5

The test flight of the gravity gradiometer survey system was taken in a flat area. In the future the test will be carried out in the rough mountain area and the topographic effect has to be taken into account. In this report the analytical downward continuation method was used to determine the gravity disturbance on the earth's topographic surface. The downward continuation is an improperly posed problem, especially in the processing of the aerial gradient data. In order to overcome this difficulty, three methods were discussed and were used for a simulated computation. The numerical computation shows that the gravity disturbance can be determined on the earth's surface with satisfied accuracy. With 1 Eotvos measure error in the gravity gradient data, the gravity disturbance was determined on the earth's surface with the accuracy of 1 mgal. The gravity disturbance was recovered with the accuracy of 3 mgal when the measure error of the gravity gradient was 5 Eotvos. GRA

N90-17231# RADEX, Inc., Bedford, MA.
INTEGRATED ANALYTICAL EVALUATION AND OPTIMIZATION OF MODEL PARAMETERS AGAINST PREPROCESSED MEASUREMENT DATA Final Report, May 1987 - May 1989
J. N. Bass, K. H. Phavnani, N. A. Bonito, K. Bounar, C. A. Hein, C. J. Jordan, W. J. McNeil, M. M. Pratt, D. S. Reynolds, and F. R. Roberts et al 23 Jun. 1989 285 p
(Contract F19628-87-C-0084)
(AD-A215518; RXR-890623; GL-TR-89-0163) Avail: NTIS HC A13/MF A02 CSCL 04/1

This contract supported investigations for integrated applications of ephemerides, physics, and mathematics of the atmosphere and near space. Projects undertaken and reported on included satellite, rocket, and astronomical circumstances; data based studies of atmospheric density and structure; spacecraft interactions leading to charging and contamination; auroral ion and electric field modeling; trapped particle, magnetic field, and instrumentation studies for CRRES; shuttle simulation and mission support; POLAR BEAR imaging and attitude determination; scintillation and spaced receivers; GE (Group Encoded) OTHB Radar processing system; lightning detection; file generating systems for ephemeris and attitude; study of common data formats; and software for interactive graphics. GRA

N90-17232# Kiruna Geophysical Inst. (Sweden). Dept. of Space Physics.
KIRUNA GEOPHYSICAL DATA Data Summary Report, Jan. - Mar. 1989
Bo Thelin, ed. 1989 51 p
(PB90-123985) Avail: NTIS HC A04/MF A01 CSCL 08G

Kiruna Geophysical Data is a collection of results of ground based more or less continuous measurements of upper atmosphere variables carried out at Swedish Institute of Space Physics. The objective with the data summary is to present current geophysical data, which is related to polar upper atmospheric conditions. Main topics include Geomagnetism, Optical aurora, and Ionospheric ionization. Tables of January to March 1989 include Geomagnetic K-indices, and All-sky camera. Reproductions for January to March 1989 include Magnetogram plots and Riometer recordings. Author

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N90-17233*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ATLAS OF ALBEDO AND ABSORBED SOLAR RADIATION DERIVED FROM NIMBUS 7 EARTH RADIATION BUDGET DATA SET, NOVEMBER 1978 TO OCTOBER 1985
G. Louis Smith, David Rutan (PRC Kentron, Inc., Hampton, VA.), and T. Dale Bess Washington Jan. 1990 213 p
(NASA-RP-1231; L-16591; NAS 1.61:1231) Avail: NTIS HC A10/MF A02 CSCL 04B

An atlas of monthly mean global contour maps of albedo and absorbed solar radiation is presented. This atlas contains 7 years of continuous data from November 1978 through October 1985. The data were retrieved from measurements made by the second Earth Radiation Budget (ERB) wide field-of-view instrument, which flew on the Nimbus 7 spacecraft in 1978. The deconvolution method used to produce these data is briefly discussed here so that the user may understand their generation and limitations. These geographical distributions of albedo and absorbed solar radiation are provided as a resource for researchers studying the radiation budget of the Earth. This atlas of albedo and absorbed solar radiation complements the atlases of outgoing longwave radiation by Bess and Smith, also based on the Nimbus 6 and 7 ERB data. Author

N90-17234 Illinois Univ. at Urbana-Champaign, Savoy.
NUMERICAL SIMULATIONS OF THE RAPID CYCLOGENESIS OVER CANADA AND EVOLUTION OF A COLD FRONT OBSERVED ON 25-26 APRIL 1979 (SESAME-AVE-3) Ph.D. Thesis
Hann-Ming Henry Juang 1988 231 p
Avail: Univ. Microfilms Order No. DA8908724

The rapid development of a cyclone over Canada and a cold front over the United States were the major weather systems observed on 25-26 April 1979 during the period of SESAME-AVE (Severe Environment Storm and Mesoscale Experiment-Atmospheric Variability Experiment) III. The objectives of this study are two-fold; one is to investigate the mechanisms of this rapid cyclogenesis, the other is to discuss the synoptic- and meso-scale environment with the cold front. A regional scale prediction model, which is the quasi-Lagrangian nested model developed by Mathur (1983) and modified in this study, was used to achieve these objectives. FGGE (First GARP (Global Atmosphere Research Program) Global Experiment) level IIIb and IIb data were used as input and verification data for numerical simulations, and for a diagnostic study. There were two cyclones involved in the event over Canada (designated as cyclones A and B). Cyclone A was given rise as a shallow surface pressure low. As the incipient cyclone A was moving south-eastward, a region of high potential vorticity in the upper- and mid-troposphere, representing the tropopause folding, closed in. As a result, horizontal advection of absolute vorticity as well as differential temperature advection increased over the center of cyclone A, making cyclone A more intense and deep in its vertical extent. On the other hand, cyclone B was born shallow and remained shallow until it merged with cyclone A. Dissert. Abstr.

N90-17235*# National Aeronautics and Space Administration, Washington, DC.
NASA AERODYNAMICS PROGRAM Annual Report, 1989
Bruce J. Holmes, Edward Schairer, Gary Hicks, Stephen Wander, Isiaiah Blankson, Raymond Rose, Lawrence Olson, and George Unger Feb. 1990 445 p
(Contract NASw-4430)
(NASA-TM-4175; NAS 1.15:4175) Avail: NTIS HC A19/MF A03 CSCL 04B

Presented here is a comprehensive review of the following aerodynamics elements: computational methods and applications, computational fluid dynamics (CFD) validation, transition and turbulence physics, numerical aerodynamic simulation, drag reduction, test techniques and instrumentation, configuration aerodynamics, aeroacoustics, aerothermodynamics, hypersonics, subsonic transport/commuter aviation, fighter/attack aircraft and rotorcraft. Author

N90-17236*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
AOIPS 3 USER'S GUIDE. VOLUME 2: PROGRAM DESCRIPTIONS
Steve S. Schotz, Thomas S. Piper (General Sciences Corp., Laurel, MD.), and Andrew J. Negri Washington Jan. 1990 431 p
(NASA-TM-100725; NAS 1.15:100725) Copyright Avail: NTIS HC A19/MF A03 CSCL 04B

The Atmospheric and Oceanographic Information Processing System (AOIPS) 3 is the version of the AOIPS software as of April 1989. The AOIPS software was developed jointly by the Goddard Space Flight Center and General Sciences Corporation. A detailed description of very AOIPS program is presented. It is intended to serve as a reference for such items as program functionality, program operational instructions, and input/output variable descriptions. Program descriptions are derived from the on-line help information. Each program description is divided into two sections. The functional description section describes the purpose of the program and contains any pertinent operational information. The program description sections lists the program variables as they appear on-line, and describes them in detail. Author

N90-17237# Central Research Inst. of Electric Power Industry, Tokyo (Japan). Energy and Environment Lab.
STUDY ON LIGHTNING PARAMETERS IN THE LIGHT OF LONG GAP DISCHARGE PHENOMENA
May 1989 43 p In JAPANESE; ENGLISH summary
(DE90-734987; CRIE-T-88074) Avail: NTIS (US Sales Only) HC A03/MF A01

The numerous parameters on lightning phenomena have been cleared considerably by observations of lightning in summer and winter seasons. This report deals with the various parameters qualitatively and quantitatively on the lightning phenomena based on data of long gap tests. The main results are as follows: (1) The values for various parameters (such as the cloud-to-ground potential difference, the positive and negative charge in the cloud, the electric field strength on the ground, the charge density of stepped leader, the leader development velocity, the time-to-discharge of first stroke, the time interval between steps and so on) are estimated by a new calculation method on the lightning parameters proposed by the author. This method is applicable to not only winter lightning, but also to summer lightning; and (2) The stepped leader development velocity for lightning is estimated based on the new leader development model proposed by the author. DOE

N90-17238# Pennsylvania State Univ., University Park. Dept. of Meteorology.
ANALYSIS OF SIGNIFICANT WEATHER ON MESO-ALPHA SCALES USING CONVENTIONAL AND REMOTELY SENSED DATA: EXPLORATORY STUDIES Final Report, Oct. 1984 - Sep. 1985
Gregory S. Forbes, Dennis W. Thomson, John J. Cahir, Catherine A. Carlson, Paul J. Neiman, Scott R. Williams, and Arthur A. Person Jul. 1989 229 p
(Contract F19628-85-K-0011)
(AD-A214563; GL-TR-89-0179) Avail: NTIS HC A11/MF A02 CSCL 04/2

Studies have been made regarding the use of Doppler wind profiler data in weather analysis and forecasting. Wind profiles from the Fleming, CO and McAlevy's Fort, PA sites were used to examine a number of cases of subtle weather situations. Use of the wind profiler data, together with conventional National Weather Service rawinsonde data proved quite helpful in understanding the cause of subtle weather systems seen in either satellite imagery or in the profiler wind variations. In addition to examining the profiler winds, studies were made of the utility of profiler-derived temperature gradients, temperature advections, and lapse rate gradient information. These quantities were derived from the observed vertical wind shears, assuming that the thermal wind relationship was reasonably valid. The framework is set forth for future studies involving profiler networks. GRA

N90-17239# Air Force Geophysics Lab., Hanscom AFB, MA.
RULE-BASED SYSTEMS FOR VISIBILITY FORECASTS Final Scientific Report
Rosemary M. Dyer and Gerald L. Freeman 14 Apr. 1989 31 p
(AD-A214622; GL-TR-89-0116; ERP-1030) Avail: NTIS HC A03/MF A01 CSCL 04/2

Zeus, a prototype rule-based system for forecasting visibility, was developed and tested at three locations along the East Coast weather. Evaluation of this expert system and further studies at AFGL have led to the conclusion that, although the usefulness of such a system has been demonstrated, a more fundamental approach to the representation of the knowledge base will have to be taken if such systems are to be deployed Air Force-wide. A discussion of the structure of a meteorological knowledge base and an outline of how a generic fog forecast system might be developed are presented. GRA

N90-17240# Titan Systems, Inc., La Jolla, CA.
OPTICAL TRANSMISSION THROUGH CLOUDS Final Report
Sep. 1989 93 p Sponsored in part by DARPA, Arlington, VA
(Contract N66001-87-D-0133)
(AD-A214765; NOSC/TD-1658) Avail: NTIS HC A05/MF A01 CSCL 04/2

This report is part of an ongoing effort to characterize clouds. Analytic models have been developed for cloud transmission and simulations have been carried out for spatial and temporal spreading. A simulation was developed for radiative transfer in finite clouds in order to gain insight into cloud characteristics. This document describes the finite cloud model and its verification for a stratus cloud. GRA

N90-17241# RDP, Inc., Waltham, MA.
CASE STUDIES IN DATA ANALYSIS Final Report, 3 Feb. 1987 - 14 Jun. 1989
Andrew J. Mazzella, Jr., Dennis E. Delorey (Boston Coll., Chestnut Hill, MA.), Kevin P. Larson, and Peter Dickson, Jr. 30 Jun. 1989 26 p
(Contract F19628-87-C-0039)
(AD-A215342; GL-TR-89-0172) Avail: NTIS HC A03/MF A01 CSCL 04/2

Rainfall measurements were processed and evaluated, for future model development. Image and magnetic sensor data from polar orbiting satellites were processed and data bases were updated. GRA

N90-17242# Air Force Systems Command, Wright-Patterson AFB, OH. Foreign Technology Div.
USSR CLIMATE HANDBOOK NUMBER 27. PART 1: SOLAR RADIATION, RADIATION BALANCE AND SUNSHINE
13 Nov. 1989 43 p Transl. into ENGLISH of Spravochnik po Klimatu SSSR (USSR), v. 27, pt. 1, 1966 p 1-36
(AD-A215647; FTD-ID(RS)T-1031-89) Avail: NTIS HC A03/MF A01 CSCL 04/2

The solar radiation input is determined primarily by an astronomic factor the length of the day and the sun's elevation. The solar radiation that hits the Earth's surface is one of the basic climate-generating factors. It, in turn, greatly depends on the atmospheric circulation (manifested by cloud cover and atmospheric transparency) and the characteristics of the underlying surface (altitude above sea level, obscuration of the horizon, surface albedo). The overall character of the circulation processes in the Kamchatka Oblast' is determined by its geographic position (the territory in question is located in the latitude zone between 65 and 51 deg NL). Its proximity to the cold Asiatic continent and the presence of large water surfaces cause monsoon circulation. GRA

N90-17243# Air Force Geophysics Lab., Hanscom AFB, MA.
OBSERVING SYSTEMS SIMULATION EXPERIMENTS: THEIR ROLE IN METEOROLOGY Environmental Research Papers, 1988 - 1989
Alan E. Lipton 31 Mar. 1989 19 p
(AD-A215705; GL-TR-89-0097; AFGL-ERP-1028) Avail: NTIS HC A03/MF A01 CSCL 12/5

A particular class of simulation experiments, those designed to evaluate the use of data from a given observing system in numerical weather analysis and forecasting are examined. Simulation of data is an attractive option when evaluating a proposed observing system for which no real data are yet available, or when the experiment requires reference to atmospheric observations that can be considered perfect. An overview is provided of the use of observing systems simulation experiments (OSSEs) in meteorology. The reasons that OSSEs have been employed are discussed. The history of OSSE applications is summarized, the apparent limitations of the method are listed, and future prospects of OSSEs are discussed. GRA

N90-17244# Naval Postgraduate School, Monterey, CA.
ONR TROPICAL CYCLONE MOTION RESEARCH INITIATIVE: DATA ASSIMILATION CONSIDERATIONS FOR FIELD EXPERIMENT ANALYSES Interim Report, Oct. 1988 - Sep. 1989
Russell L. Elsberry Sep. 1989 70 p

(AD-A215726; NPS63-89-006) Avail: NTIS HC A04/MF A01 CSCL 04/2

The Office of Naval Research Tropical Cyclone Motion initiative is a five-year program to improve understanding of tropical cyclone motion. On 31 August to 1 September 1989, a workshop was held in Monterey, California to consider the characteristics of data assimilation systems for tropical analyses. The focus is on special considerations that might apply in preparing a set of final analyses of the observations to be obtained in the Tropical Cyclone Motion field experiment during August and September 1990. The basic characteristics of the analysis grid, handling of the special experimental observations, objective analysis considerations, data assimilation procedures, inclusion of bogus observations, initialization techniques, and other considerations are summarized. GRA

48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

N90-17245# Electronics Research Lab., Adelaide (Australia).
A STATISTICAL MODEL OF THE INFRARED SIGNATURE OF A WIND ROUGHENED SEA
S. A. Brunker and G. Hamlyn Mar. 1989 37 p
(AD-A214531; ERL-0473-TR; DODA-AR-005-879) Avail: NTIS HC A03/MF A01 CSCL 08/3

The response of any Optical System, used in either a weapon or surveillance mode, is dependent upon the emission of electromagnetic energy from both target and background occupying the field of view. The background not only contributes to the infrared scene (clutter) but, additionally, by reflection and absorption, can significantly contribute to the target's signature. Since the maritime environment can be conceived as containing an opaque homogeneous body of water, its signature will depend on upon the predictable behavior of such a surface in response to the natural elements. This report proposes a statistical-numerical method which can be used to obtain the infrared signature of both a calm and wind roughened sea in the 1 to 15 micron waveband. GRA

N90-17246# Naval Ocean Research and Development Activity, Bay Saint Louis, MS.
THE POLAR ICE PREDICTION SYSTEM: A SEA ICE FORECASTING SYSTEM Final Report
Ruth H. Preller and Pamela G. Posey (Berkeley Research Association, Springfield, VA.) Apr. 1989 50 p
(AD-A214600; NORDA-212) Avail: NTIS HC A03/MF A01 CSCL 08/12

The Polar Ice Prediction System PIPS, based on the Hibler dynamic/thermodynamic sea ice model, was developed as an upgrade to the existing sea ice products available at the Navy's Fleet Numerical Oceanography Center (FNOC). It was also designed to provide new sea ice products that could be used as guidance by the Naval Polar Oceanography Center (NPOC). Operational testing of PIPS showed that the ice drift from the model was excessive in magnitude when compared to ice drift from Arctic buoys. As a result, the PIPS forcing was changed from planetary boundary layer model winds to geostrophic winds calculated from forecast surface pressures. Resultant PIPS ice drifts were more accurate than those calculated by the existing operational model-the Thorndike and Colony free-drift model. The operational test also indicated a need to reduce the model time step from 24 to 6 hours. Reducing the time step allowed for better resolution of atmospheric heat fluxes and improved the model's capability to predict ice edge location. PIPS results also showed great improvement when updated by an ice concentration analysis for the Arctic derived by NPOC. This updating technique is now an integral part of the PIPS system and takes place approximately once per week. As a result of this testing and the associated improvements made to the model, PIPS was declared operational 1 September 1987. GRA

N90-17247# Colorado School of Mines, Golden. Center for Wave Phenomena.
PHASE SPACE AND PATH INTEGRAL METHODS APPLIED TO DIRECT AND INVERSE OCEAN SEISMO-ACOUSTIC MODELING Final Report, 1 Oct. 1987 - 30 Jun. 1989
Louis Fishman 15 Nov. 1989 10 p
(Contract N00014-88-K-0047)
(AD-A214777; CSM-2684) Avail: NTIS HC A02/MF A01 CSCL 20/14

The long-range objective is to develop and apply microscopic phase space methods and global path integral constructions to gain a deeper theoretical and computational understanding of electromagnetic, seismic, and acoustic direct and inverse wave propagation problems. Specifically, this project focuses on the development of new multidimensional algorithms for direct (forward) acoustic propagation and generalized acoustic tomography at the level of the reduced scalar Helmholtz equation. The introduction and widespread application of the parabolic (paraxial) approximation marked a significant advance in wave propagation modeling for ocean seismo-acoustic and other strong channeling environments. In many respects, this is a most natural motivation for the application of phase space factorization and path integral methods to the Helmholtz equation. GRA

N90-17248# Pacific Missile Test Center, Point Mugu, CA.
TIDAL AND LUNAR DATA FOR POINT MUGU, SAN NICOLAS ISLAND, AND THE BARKING SANDS AREA DURING 1990 Annual Report
Rich Dixon 31 Dec. 1989 36 p
(AD-A214828; PMTC-TP-000051) Avail: NTIS HC A03/MF A01 CSCL 08/3

Basic lunar and tidal data for Point Mugu, San Nicolas Island and the Barking Sands Area during 1990 are provided. The data presented are: (1) Tidal data; (2) times of moonrise and moonset; (3) times of lunar phases, and (4) times of sunrise and sunset. GRA

N90-17249# Physical Dynamics, Inc., La Jolla, CA.
MEASUREMENT OF FLUCTUATIONS IN THE TILT OF ARCTIC ICE AT THE CEAREX OCEANOGRAPHY CAMP: EXPERIMENT REVIEW, DATA CATALOG, AND PRELIMINARY RESULTS
Peter V. Czipott and Walter N. Podney Sep. 1989 57 p
(Contract N00014-89-C-0087)
(AD-A215059; PD-LJ-89-369R) Avail: NTIS HC A04/MF A01 CSCL 08/12

Three tiltmeters set in a triangular array on the eastern Arctic Ocean near 83 deg N, 10 deg E produced high quality data 30 Mar. to 19 Apr. 1989, as part of the Coordinated Eastern Arctic Experiment (CEAREX). Spectra of tilt fluctuations show the same features as those from the Arctic Internal Wave Experiment (AIWEX), recorded Apr. 1985 on the Beaufort Sea near 74 deg N, 145 deg W. They show a spectral peak centered near a period of 40 seconds, which results from a long period swell coming from open seas, together with a sharp rise in spectral density below a frequency of several cycles per hour, which comes from internal waves. A pronounced spectral valley or window, from about 2 MHz to 20 MHz, separates the two dominant features. In addition to quasi-stationary fluctuations that give the dominant spectral features, the data reveal three kinds of intermittent activity: (1) solitary internal waves emanating from the direction of the Yermak Plateau; (2) seismic-like signals coming from ice rupture; and (3) rapid oscillations with periods of a few seconds, lasting for tens of minutes, that possibly arise from rigid oscillations of an ice floe driven by wind gusts. Fluctuations in tilt are highly coherent with in situ temperature fluctuations that come from a solitary internal wave packet, but fluctuations in strain show little coherence. GRA

N90-17250# Naval Postgraduate School, Monterey, CA.
SEA SURFACE TEMPERATURE FIELDS DERIVED FROM AIRCRAFT AND SHIP OBSERVATIONS DURING FASINEX
1986 Interim Report, Nov. 1986 - Jun. 1989
Richard J. Lind and William J. Shaw May 1989 45 p
(AD-A215727; NPS63-89-001) Avail: NTIS HC A03/MF A01 CSCL 08/3

Measurements of sea surface temperature during low-level flights by the National Center for Atmospheric Research Electra aircraft and by ships R/V Endeavor and R/V Oceanus, during the Frontal Air-Sea Interaction Experiment (FASINEX), are combined to map the sea surface temperature field over a 90 by 100 km region of five days of the experiment (16, 17, 18, 21 and 24 February 1986). Distributions of sea surface temperature, interpolated to a regularly space grid, are presented in the form of contour maps for each day. The position and intensity of an ocean front, lying within the region, and other features in the sea surface temperature field, are documented. Derivation of sea surface temperature from aircraft measurements, data processing methods, and incorporation of ship measurements are described. GRA

51 LIFE SCIENCES (GENERAL)

N90-17251*# National Aeronautics and Space Administration, Washington, DC.
THE 1988-1989 NASA SPACE/GRAVITATIONAL BIOLOGY ACCOMPLISHMENTS
Thora W. Halstead, ed. Jan. 1990 225 p Prepared in cooperation with George Washington Univ., Washington, DC
(Contract NASw-4324)
(NASA-TM-4160; NAS 1.15:4160) Avail: NTIS HC A10/MF A02 CSCL 06C

This report consists of individual technical summaries of research projects of NASA's space/gravitational biology program, for research conducted during the period May 1988 to April 1989. This program is concerned with using the unique characteristics of the space environment, particularly microgravity, as a tool to advance knowledge in the biological sciences; understanding how gravity has shaped and affected life on Earth; and understanding how the space environment affects both plant and animal species. The summaries for each project include a description of the research, a list of the accomplishments, an explanation of the significance of the accomplishments, and a list of publications. Author

N90-17252* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
BIO-REACTOR CHAMBER Patent
Joseph A. Chandler, inventor (to NASA) 13 Jun. 1989 9 p
(NASA-Case-MSC-20929-1; US-Patent-4,839,046; US-Patent-Appl-SN-087358; US-Patent-Class-210-355; US-Patent-Class-210-414; US-Patent-Class-435-311; US-Patent-Class-435-316) Avail: U.S. Patent and Trademark CSCL 06C

A bioreactor for cell culture is disclosed which provides for the introduction of fresh medium without excessive turbulent action. The fresh medium enters the bioreactor through a filter with a backwash action which prevents the cells from settling on the filter. The bioreactor is sealed and depleted medium is forced out of the container as fresh medium is added. Official Gazette of the U.S. Patent and Trademark Office

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

N90-17253# Florida Univ., Gainesville. Dept. of Psychology.
AUDITORY PATTERN MEMORY: MECHANISMS OF TONAL SEQUENCE DISCRIMINATION BY HUMAN OBSERVERS
Annual Report, 1 Oct. 1988 - 31 Oct. 1989
Robert D. Sorkin 31 Oct. 1989 17 p
(Grant AF-AFOSR-0021-89; AF Proj. 2313)
(AD-A214494; AFOSR-89-1349TR) Avail: NTIS HC A02/MF A01 CSCL 06/4

A series of experiments testing the discrimination of random temporal patterns (single frequency tone sequences) was performed. The observer's task was to discriminate whether two sequences of tones contained the same or different patterns of temporal gaps. Half of the experimental trials contained gap sequences that were perfectly correlated across the two sequences (e.g., the temporal patterns were identical), and half the trials contained gap sequences that were partially correlated (the correlation was controlled by adding the outputs of two normal deviate generators). A model of discrimination, based on computation of the sample correlation between the gaps, and limited by a fixed source of internal (independent) temporal noise, allowed good prediction of observer performance. Some additional sources of variance were due to encoding or memory limitations. The correlation model makes specific predictions about the consequences of sequence time compression and expansion on performance; experiments are under way to evaluate the effects of these transformations. GRA

N90-17254# Army Aeromedical Research Lab., Fort Rucker, AL. Biodynamics Research Div.
SIMULATOR SICKNESS IN THE AH-1S (COBRA) FLIGHT SIMULATOR Final Report
Daniel W. Gower, Jr. and Jennifer Fowlkes (Essex Corp., Orlando, FL.) Sep. 1989 78 p
(DA Proj. 3E1-62777-A8-79)
(AD-A214562; USAARL-89-20) Avail: NTIS HC A05/MF A01 CSCL 06/10

Field studies of operational flight simulators were conducted to assess the incidence and severity of simulator sickness. Simulator sickness here refers to the constellation of motion sickness related symptoms that occur in simulators due to visual representation, motion base representation, or combination of the two representations of flight. The incidence rates and relative frequency of specific symptoms are presented. Correlational factors such as recent simulator experience, current state of health, overall flight experience, mission scenario, and flight dynamics are presented. The Army's flight simulators are ranked in comparison to the 10 Navy simulators studied by the Naval Training Systems Center, Orlando, FL. The need is reinforced for studies to understand perceptual rearrangement, adaptation/readaptation, and pilot susceptibility to the effects of simulation. Design criteria for simulators, as well as those training guidelines necessary to cope with this phenomenon also must be addressed. GRA

N90-17255# Army Aeromedical Research Lab., Fort Rucker, AL. Sensory Research Div.
EVALUATION OF TWO OBJECTIVE MEASURES OF EFFECTIVE AUDITORY STIMULUS LEVEL
Ted L. Langford, Ben T. Mozo, and James H. Patterson, Jr. Aug. 1989 28 p
(AD-A214669; USAARL-89-18) Avail: NTIS HC A03/MF A01 CSCL 06/16

The brainstem auditory evoked response and the 40-Hz component of the auditory mid-latency response were measured in human subjects as a function of stimulus frequency and level to determine whether one of the two could be used to provide a reliable estimation of the amount of attenuation provided by hearing protective devices in situations in which the time available for measurement is restricted. Under the conditions of the present experiment, the variability of the data for both types of measure

was too great to permit a reliable estimation of effective stimulus level. Potentially harmful noise levels in many military environments require the use of hearing-protective devices by personnel operating in those environments. A rapid, reliable, and valid method for the field measurement of the amount of attenuation afforded by the various hearing protectors is needed to ensure that the devices are being properly used and are effective in reducing noise exposure. At present, a method for objectively measuring the attenuation of hearing protectors in a field environment is not available. GRA

N90-17256# Naval Aerospace Medical Research Lab., Pensacola, FL.
A REVIEW OF CIRCADIAN EFFECTS ON SELECTED HUMAN INFORMATION PROCESSING TASKS Interim Report
Diane L. Damos 3 Apr. 1989 37 p
(AD-A214673; NAMRL-MONOGRAPH-37) Avail: NTIS HC A03/MF A01 CSCL 06/4

This monograph examines the magnitude of circadian effects on selected information processing tasks. The monograph begins with a brief discussion of the statistical and methodological problems associated with assessing circadian effects. The remainder of the monograph reviews the pertinent literature. Each study is described briefly first and critically examined from a methodological standpoint. Then, the maximum and minimum circadian effects are presented as a percentage of mean performance to allow the results to be compared across studies. Approximately half of the statistical tests conducted to detect circadian effects were nonsignificant. The majority of circadian effects, regardless of their statistical significance, showed less than a 10 percent difference between mean performance and either the maximum or minimum performance. GRA

N90-17257# Naval Aerospace Medical Research Lab., Pensacola, FL.
IDENTIFYING THE CIRCADIAN CYCLE IN HUMAN INFORMATION PROCESSING DATA USING PERIODICITY ANALYSIS: A SYNOPSIS Interim Report
Diane L. Damos 3 Apr. 1989 9 p
(AD-A214674; NAMRL-TM-89-1) Avail: NTIS HC A02/MF A01 CSCL 06/4

Data from human information processing tasks frequently cannot satisfy the assumptions of many common periodicity techniques. This memorandum identifies appropriate techniques for data that cannot meet all of the assumptions of the more familiar ones. GRA

N90-17258# Defence Research Establishment Atlantic, Dartmouth (Nova Scotia). Research and Development Branch.
HUMAN FACTORS IN THE NAVAL ENVIRONMENT: A REVIEW OF MOTION SICKNESS AND BIODYNAMIC PROBLEMS
James L. Colwell Sep. 1989 70 p
(AD-A214733; DREA-TM-89/220) Avail: NTIS HC A04/MF A01 CSCL 06/10

Two types of motion-induced problems affecting human performance in the naval environment are reviewed; motion sickness and biodynamic problems. Methods for predicting the incidence of motion sickness are described and evaluated, and problems associated with modeling complex motions are discussed. References for quantifying habituation are cited and methods for defining the severity of motion sickness symptoms are described. Biodynamic problems are briefly discussed, including the low-frequency, large-amplitude problems of motion-induced interruptions (MII) and fatigue; and the higher-frequency problems of manual control and vision. Methodologies and criteria for evaluating human performance within the systems approach to seakeeping assessment are discussed and topics for future work are recommended. GRA

N90-17259# Human Systems Div., Brooks AFB, TX.
ENVIRONMENTAL QUALITY AND OCCUPATIONAL HEALTH SPECIAL EMPHASIS AREA PLAN (SEAP) Final Report, Sep. 1988 - May 1989
John C. Bonnin and Richard B. Drawbaugh Jun. 1989 24 p
(AD-A214738; HSD-SR-89-019) Avail: NTIS HC A02/MF A01 CSCL 06/14

The Deputy for Development Planning, Human Systems Division, is tasked with performing studies and analyses to identify future requirements in the areas of crew protection and aerospace medicine, crew system integration, force readiness, and environmental protection. This special Emphasis Area Plan (SEAP) focuses on the functional area of environmental protection, identifying systems and enabling technologies needed to support the goals of Air Force environmental programs. This SEAP also lists Air Force Systems Command programs related to these systems and technologies and assesses the time frame and criticality of each technology relative to the system it supports. Systems discussed include hazardous material identification and toxicity evaluation systems, cost modeling systems, improved industrial hygiene and waste minimization systems, environmental monitoring technology evaluation systems, and simulation and testing facilities, risk analysis and cost projection systems, and long term environmental planning systems. Enabling technologies include biologically based toxicity computer modeling, rapid toxicity screening, tiered approach to toxicity testing, artificially intelligent expert toxicology system, combustion toxicology standards, hydraulic fluids toxicology studies, standards for evaluating engineering trade-offs, cost models, and analysis methods. GRA

N90-17260# University of Central Florida, Orlando.
THE EFFECTS OF FOVEAL LOAD ON PERIPHERAL SENSITIVITY IN THE VISUAL FIELD Final Report
Edward J. Rinalducci Oct. 1989 39 p
(Contract DAAL03-87-K-0014)
(AD-A214872; ARO-24828.1-LS) Avail: NTIS HC A03/MF A01 CSCL 06/4

The main objective of this research was to investigate the effects of foveal load on sensitivity in the peripheral visual field. In the first of a series of four experiments, foveal load was manipulated by comparing the fixation of a cross vs. a simple first-order compensatory tracking task display. Peripheral sensitivity was determined simultaneously for light flashes presented at different eccentricities along the horizontal meridian. In general, the results showed no losses in peripheral sensitivity or a tunnel vision effect under the experimental conditions employed. In the three subsequent experiments, more complex tracking tasks were employed in order to vary foveal load. The difficulty of the perimetry task has also been manipulated in the fourth experiment by including lights on the vertical, as well as the horizontal meridian. Whether or not a loss or a gain in peripheral sensitivity was obtained depended upon the complexity of the foveal task and to some extent the difficulty of the perimetry task. Results are discussed in terms of arousal and resource theory, and recommendations are made for future research in this area. GRA

N90-17261# Naval Medical Research Inst., Bethesda, MD.
STATISTICALLY BASED DECOMPRESSION TABLES 5: HALDANE-VANN MODELS FOR AIR DIVING Final Report, Jan. 1987 - Nov. 1988
Y. J. Parsons, P. K. Weathersby, S. S. Survanshi, and E. T. Flynn Feb. 1989 64 p
(AD-A214934; NMRI-89-34) Avail: NTIS HC A04/MF A01 CSCL 06/10

The analysis is continued of air decompression diving by probabilistic models evaluated using the statistical tool of maximum likelihood. Models based on the traditional deterministic calculations of Haldane have been placed in a probabilistic formalism by Vann. The ability of these models to fit data examined in the first and fourth reports in the present series were explored here. The computationally simpler Haldane-Vann (H-V) models achieved comparable success fitting relatively homogeneous data to the risk models used in the earlier reports in this series. However, H-V models were unable to deal successfully with larger and more diverse collections of data. It appears that the Vann definition of decompression dose intrinsically cannot lead to simultaneously successful predictions of both short and long air dives. GRA

N90-17262# Air Force Systems Command, Wright-Patterson AFB, OH. Foreign Technology Div.
THE CHARACTERISTICS OF PHYSIOLOGICAL RESPONSES AND TOLERANCE EVALUATION OF PRESSURE BREATHING
Jingshan Chen, Baolan Zhang, and Siguang Jia 12 Oct. 1989 18 p Transl. into ENGLISH from Acta Aeronautica et Astronautica Sinica (Peoples Republic of China), v. 10, no. 2, Feb. 1989 p 59-65 Original language document was announced in IAA as A89-39476
(AD-A214991; FTD-ID(RS)T-0827-89) Avail: NTIS HC A03/MF A01 CSCL 06/4

Experiments were performed on 6 young healthy males during pressure breathing without trunk counter-pressure. The values of intra-pulmonary pressure used were 0, 2.0, 3.0, 3.4, 4.0, 4.4 and 5.4 kPa. The results were summarized as follows. With the increase of pressure within the lung, the compensatory functions of circulatory and respiratory power consumption index was increased, but it was dropped as the intra-pulmonary pressure reached 4.0 kPa. The decrease of above objective physiological indices showed that the compensatory function was weakened, which was the indication of physiological endurance limit during pressure breathing. There was a serious subjective symptom for the breathing to be continued difficulty experimental examples discontinued only, that maybe considered as the acceptable endurance index. The respiratory power consumption index can reflect respirodynamically physiological characteristics of subjective sensation in human during pressure breathing which may be used as a co-indicator for the evaluation of the tolerance of pressure breathing was presented through the experiment. The intra-pulmonary pressure of 2.0, 3.4, and from 4.0 to 6.2 kPa was considered to be the physiological limit of safety, allowance and endurance. This study denoted marked significance for establishing physiological standard and protective measure of pressure breathing by oxygen. GRA

N90-17263# NSI Technology Services Corp., Dayton, OH.
PROCEEDINGS OF THE 17TH CONFERENCE ON TOXICOLOGY Interim Report
Sep. 1989 424 p Conference held in Dayton, OH, 3-5 Nov. 1987
(Contract F33615-85-C-0532; AF Proj. 6302)
(AD-A215076; AAMRL-TR-89-027; NMRI-89-58) Avail: NTIS HC A18/MF A01 CSCL 06/11

This series of manuscripts from the 17th Conference on Toxicology addresses critical research and development issues for quantitatively assessing the health risks associated with various occupational and environmental exposures. To meet the needs of the Department of Defense, these contributions focus on the current knowledge of quantitative methods in toxicology especially as applied to military systems or military operations. These manuscripts present state-of-the-art methodologies that will improve our ability to develop objective indices of toxicity keeping in mind that the ultimate purpose is to predict expected human toxicity. GRA

N90-17264# Army Research Inst. of Environmental Medicine, Natick, MA.
TEMPERATURE REGULATION DURING UPPER BODY EXERCISE: ABLE BODIED AND SPINAL CORD INJURED
Michael N. Sawka, William A. Latzka, and Kent B. Pandolf Apr. 1989 34 p
(DA Proj. 3M1-6287-A-879)
(AD-A215130) Avail: NTIS HC A03/MF A01 CSCL 06/10

This paper will consider human thermoregulatory response differences between upper and lower body exercise. In addition, the thermoregulatory problems of spinal cord injured individuals are examined. For able-bodied individuals, the rise in core temperature is independent of the skeletal muscle mass employed and dependent upon the metabolic rate during exercise. The avenues of heat exchange, however, are different for individuals performing upper body and lower body exercise. During upper body exercise, there is a greater dry heat loss from the torso, however, no additional heat loss (as compared to lower body exercise) occurs from the exercising arms. If an individual performs upper body exercise in cold water, he/she will lose a greater amount of heat and be more susceptible to hypothermia than during lower body exercise. A spinal cord injury will impair man's ability to thermoregulate because of: (1) loss of vasomotor and sudomotor control to the areas of the insensate skin; (2) a reduced thermoregulatory effector response for a given core temperature; and (3) a loss of skeletal muscle pump activity from the paralyzed limbs. GRA

N90-17265# Army Research Inst. of Environmental Medicine, Natick, MA.
PRE-TREATMENT WITH TYROSINE REVERSES HYPOTHERMIA INDUCED BEHAVIORAL DEPRESSION
T. Michael Rauch and Harris R. Lieberman (Massachusetts Inst. of Tech., Cambridge.) Sep. 1989 20 p
(AD-A215211) Avail: NTIS HC A03/MF A01 CSCL 06/15

Cold exposure accelerates the firing frequency of norepinephrine (NA) neurons, enhancing NA release and leading to NA depletion in specific regions of the brain. The accelerated firing activates the enzyme tyrosine-hydroxylase, making it more tyrosine sensitive. The reduction of brain NA is accompanied by a behavioral depression on the open field test. Two experiments were performed on adult male rats. First, it was determined whether systematic lowering of core body temperature produced behavioral depression in the swim test. Second, treatment with the NA precursor tyrosine was employed in an attempt to prevent hypothermia-induced behavioral depression. In experiment 1, two levels of hypothermia were highly effective in producing behavioral depression in rats forced to swim in a narrow cylinder containing water. In experiment 2, treatment with tyrosine (400 mg/kg, ip) thirty minutes prior to the hypothermia procedure completely reversed the behavioral depression found in experiment 1. Tyrosine administration did not significantly influence the rate of deep body cooling during the hypothermia treatment. GRA

N90-17266# Army Research Inst. of Environmental Medicine, Natick, MA.
SENSATIONS OF TEMPERATURE AND HUMIDITY DURING INTERMITTENT EXERCISE AND THE INFLUENCE OF UNDERWEAR KNIT STRUCTURE
Ruth Nielsen (National Inst. of Occupational Health, Solna, Sweden) and Thomas L. Endrusick Sep. 1989 22 p
(AD-A215285) Avail: NTIS HC A03/MF A01 CSCL 06/10

In occupational as well as recreational outdoor activities, intermittent exercise is common. In autumn and winter, a varying activity level may easily result in periods of sweating and chilling. In these situations, thermoreceptors are of significance for automatic temperature regulation, and for conscious sensation of the temperature of the body and of the actual environment. The sensitivity to thermal stimuli varies between the core and different body surface areas. Humans have no humidity receptors, but in some way the wetness of the skin is also sensed, and can be related to the evaluation of comfort and discomfort. Also, the clothing worn generates thermal and contact wearing sensations. The purpose was to investigate the development of various subjective temperature and humidity sensations of the body, of the skin-clothing interface, and of the environment in dressed subject's during intermittent exercise in an environment resulting in both periods of sweating and chilling. Further, we aimed to study the significance of the knit structure in underwear during the course of the subjective sensations, and whether there was any correlation between subjective sensations and physiological/physical observations. GRA

N90-17267# Army Research Inst. of Environmental Medicine, Natick, MA. Exercise Physiology Div.
EFFECTIVENESS OF PROGRESSIVE RESISTANCE TRAINING FOR INCREASING MAXIMAL REPETITIVE LIFTING CAPACITY
Marilyn A. Sharp, Everett A. Harman, Brian E. Boutilier, Matthew W. Bovee, and William J. Kraemer 27 Oct. 1989 27 p
(AD-A215286) Avail: NTIS HC A03/MF A01 CSCL 05/9

The purpose was to investigate the effects of 12 weeks of

progressive resistance training on the performance of a high intensity repetitive lifting task. The repetitive lifting task consisted of lifting a 41 kg box to a chest high shelf as many times as possible in 10 min. Subjects were randomly assigned to a training (TR) or a control group (CT). The TR group (n=18) participated in progressive resistance training 3 times each week for 12 weeks. The CT group (n=7) was asked to maintain their current exercise habits which did not include progressive resistance training. Repetitive lifting task performance and one repetition maximum strength for box lift, bench press, deadlift and squat were recorded before and after progressive resistance training. Improvement in the strength of the training group was significantly greater (p less than .05) than that of the CT group. The increase in strength was accompanied by greater change (p less than .05) in repetitive lifting task performance for the training group (pre-test = 79.1 lifts, post-test = 92.4 lifts) than the CT group (pre-test = 84.9 lifts, post-test = 82.0 lifts). It is concluded that traditional progressive resistance training exercises are effective in improving performance of an occupational lifting task. Regular progressive resistance training can be particularly important in maintaining the effectiveness of manual workers in jobs that require high intensity lifting on an infrequent basis. GRA

N90-17268# Naval Biodynamics Lab., New Orleans, LA.
GUIDELINES FOR SAFE HUMAN EXPOSURE TO IMPACT ACCELERATION, UPDATE A
Marc S. Weiss, David L. Matson, and Stephen T. Mawn 1 Sep. 1989 16 p
(AD-A215287; NBDL-89R003) Avail: NTIS HC A03/MF A01 CSCL 06/10

Tolerance levels for living human volunteers are defined and developed for minimum risk injury. The experimentally safe levels of impact, derived from a variety of sources, are suggested as guidelines for torso-restrained volunteers, where the freely moving head and neck are the anatomical segments most at risk. These recommended limits are no greater than the maximum exposures already experienced by Naval Biodynamics Laboratory's volunteers. No injuries have been sustained at these levels. GRA

N90-17269# Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
STRUCTURAL ALTERATIONS IN THE CORNEA FROM EXPOSURE TO INFRARED RADIATION Final Report, 1 Apr. 1986 - 14 Apr. 1988
R. A. Farrall, R. L. McCally, C. B. Bargeron, and W. R. Green Aug. 1989 31 p
(DA Proj. 3E1-62787-A8-78)
(AD-A215340) Avail: NTIS HC A03/MF A01 CSCL 06/10

Research is summarized for the interaction of infrared radiation, especially from high-intensity CO2 TEA lasers, with the cornea. The research reported here was performed between April 1, 1986 and April 14, 1988. The threshold epithelial damage from single- and multiple-pulse exposures, material ejection from the anterior corneal surface, lesion histology, and possible damage mechanisms are discussed. GRA

N90-17270# Naval Submarine Medical Center, Groton, CT.
WORKSHOP ON THE EFFECTS OF COMBINED FIRE PRODUCTS ON HUMAN PHYSIOLOGICAL AND PSYCHOLOGICAL PERFORMANCE Final Report, period ending Nov. 1987
A. B. Callahan, C. A. Harvey, and C. H. Pohler (Naval Sea Systems Command, Washington, DC.) 9 Aug. 1989 12 p Workshop held in Groton, CT, 16-18 Nov. 1987
(AD-A215465; NSMRL-SP89-4) Avail: NTIS HC A02/MF A01 CSCL 06/4

This report summarizes the discussion and conclusions reached at a Workshop on the Effects of Combined Fire Products on Human Physiological and Psychological Performance. The workshop was held at the Naval Submarine Medical Research Laboratory on 16 to 18 Nov. 1987. GRA

N90-17271# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
AN EXPLORATORY ANALYSIS OF MOTION SICKNESS DATA: A TIME SERIES APPROACH M.S. Thesis
David C. Thompson Dec. 1989 151 p
(AD-A215534; AFIT/GSO/EMS/89D-15) Avail: NTIS HC A08/MF A01 CSCL 06/10

A methodology was developed in order to characterize the prodigious amount of electroencephalographic (EEG) data collected during motion sickness experiments at the Air Force Institute of Technology. The analog data are sampled and digitized into a time series. Stationarity transformations and a windowing operation are performed on the data to produce local areas of stationarity. Windowed versions of the autocorrelation function, partial autocorrelation function and periodogram are discussed and employed. The windows are analyzed over time in order to view the underlying structure of the model that is hidden in the data. These functions are converted into image files to aid interpretation. The images are directly interpreted for model determination, model changes, artifact assessment and stationarity determination. A primary subject and two confirming subjects are analyzed. Both a placebo trial and Dilantin trial were analyzed for each subject to determine the nature of motion sickness and the efficacy of the drug treatment. The results are inconclusive as all three subjects brain data proved to be unique with respect to the placebo trials. GRA

N90-17272# Army Research Inst. of Environmental Medicine, Natick, MA.
PSYCHOLOGICAL AND PHYSIOLOGICAL RESPONSES OF BLACKS AND CAUCASIANS TO HAND COOLING Final Report, Sep. 1985 - Jun. 1989
Ronald L. Jackson, Donald E. Roberts, Randy A. Cote, Patrick McNeal, and Janet T. Fay Jun. 1989 57 p
(AD-A215646; USARIEM-T20-89) Avail: NTIS HC A04/MF A01 CSCL 06/10

The factors contributing to the susceptibility of Blacks and Caucasians to cold sensitivity are investigated. Control measurements were taken for 10 minutes in room air for 112 male subjects (52 Blacks and 60 Caucasians), 18 to 41 years of age. Immediately following the control period, one hand was immersed for 20 minutes in 5 C, stirred cold water. Cardiovascular responses and hand blood flow (BF) were monitored once every minute. Middle finger temperature (Tmf) of the immersed and non-immersed hands was measured every 30 sec. Before cold water immersion, Tmf was higher for Caucasians than Blacks. During 20 minutes of cold water immersion, Tmf remained significantly higher in Caucasians compared to Blacks. Lower Tmf in Blacks may be a result of a greater sympathetic response to the cold water stress as noted by the heart rate, blood pressure, and non-immersed BF values during the initial minutes of cold water immersion. Data from this study support previous reports that peripheral cold sensitivity is greater in Blacks when compared to Caucasian individuals of similar age and physical characteristics. Another possible determinant of finger temperature during the cold water immersion test as demonstrated in this study was the level of prior cold weather experience (CE) an individual possessed. Tmf was dependent on level of CE to a greater degree than geographic origin alone. GRA

N90-17273# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
A CEPSTRAL ANALYSIS OF EEG (ELECTROENCEPHALOGRAPHIC) SIGNALS IN MOTION SICKNESS STUDIES M.S. Thesis
Russel B. Smith Dec. 1989 83 p
(AD-A215663; AFIT/GSO/ENG/89D-1) Avail: NTIS HC A05/MF A01 CSCL 06/10

Electroencephalographic (EEG) signals were studied during the evolution of motion sickness. Cepstral transformation techniques and hypothesis testing were used to investigate the relationships between phenytoin serum levels and malaise period EEG signals. The same techniques were used to study the relationships between

phenytoin-malaise period EEG signals and placebo-malaise period EEG signals. The relationships between pre-malaise period EEG signals for phenytoin and placebo trials were also studied. Eighteen male subjects were given the drug phenytoin in a double-blind, placebo-controlled crossover experiment. Subjects were rotated in a motion chair while eight physiological parameters were measured. Although the drug delayed or prevented the onset of emesis, no statistically significant relationships were found between phenytoin serum levels and frontal-midline EEG signals. GRA

N90-17274# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

MEASUREMENT OF THE IMPULSE RESPONSE OF THE HUMAN VISUAL SYSTEM USING CORRELATION TECHNIQUES M.S. Thesis

Edward A. Colley Dec. 1989 66 p

(AD-A215667; AFIT/GE/ENG/89D-8) Avail: NTIS HC A04/MF A01 CSCL 06/5

Random signal testing techniques are applied to the human visual system. A binary maximal length sequence was used to modulate a fluorescent light bank by about 15 percent. With this pseudo-random noise as a visual input, subjects were monitored with an electroencephalograph (EEG). The cross correlation between the pseudo-random input and the EEG output yields an estimate of the subject's visual system impulse response. An attempt was made to verify the impulse response using matched filter theory. GRA

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N90-17275# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Aerospace Medical Panel.

HUMAN BEHAVIOUR IN HIGH STRESS SITUATIONS IN AEROSPACE OPERATIONS

Jun. 1989 200 p In ENGLISH and FRENCH Symposium held in Hague, Netherlands, 24-28 Oct. 1988

(AGARD-CP-458; ISBN-92-835-0517-4) Copyright Avail: NTIS HC A09/MF A02; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

These Proceedings include the Technical Evaluation Report, the Keynote Address, 20 papers and ensuing discussions from the Symposium sponsored by the AGARD Aerospace Medical Panel held in The Hague, The Netherlands from 24 to 28 October 1989. As the human operator is more and more clearly shown to be the limiting factor in the operational performance of modern aerospace systems, more and more rigorous selection criteria must be applied for psychological as well as medical selection of aircrew. This Symposium examined this problem from the point of view of human behavior in high stress situations specifically looking at incident and accident experience, personality traits, responses to stress and prediction of behavioral responses. These proceedings will be of interest to those involved with the psychological selection and/or assessment of aircrew. For individual titles, see N90-17276 through N90-17295.

N90-17276# Royal Air Force Inst. of Aviation Medicine, Farnborough (England).

CAUSES OF AIRCREW ERROR IN THE ROYAL AIR FORCE

J. W. Chappelow *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations Jun. 1989 9 p (For primary document see N90-17275 09-53)

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One hundred and forty nine military flying accidents were investigated by psychologists. Inspection of the data collected revealed that nearly half of the accidents involved inadequacies in equipment design, training or administration. Cognitive failure was a major cause of aircrew error and was more often associated with underarousal than with overarousal. Overarousal made a significant contribution to aircrew error, but largely as a secondary factor, i.e., it was generally a consequence of mechanical problems, disorientation, or prior mishandling of the aircraft. Personality factors also made a significant contribution, and the data suggest two distinct types of problem. Life stress and high workload appeared not to play a major part in stress-related accidents. Fatigue was not a major factor, but was closely associated with cognitive failure. Author

N90-17277# Belgian Air Force, Brussels. Medical Aerospace Center.

REVIEW OF SERIOUS AIRCRAFT ACCIDENTS IN THE BELGIAN AIR FORCE: CAUSES AND COMPARISON WITH SELECTION DATA Report, Sep. 1973 - Jun. 1986 [REVUE DES ACCIDENTS AERIENS GRAVES A LA FORCE AERIENNE BELGE: CAUSES ET COMPARAISON AVEC QUELQUES DONNEES DE SELECTION]

J-C. Genon, P. Teck, and P. Vandenbosch *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations Jun. 1989 12 p In FRENCH (For primary document see N90-17275 09-53)

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Methods used by the Belgian Air Force for the analysis of aircraft accidents are outlined. Accident base data and the causal factors employed in the analyses are described. Causal factors are grouped into three categories including human factors, inexperience, and external (non-human) factors. Accident data are presented for each factor in isolation and factors conjugated with other factors. The relation between causal factors and pilot selection data (psychometric and personality) is also examined. Transl. by M.G.

N90-17278# Royal Norwegian Air Force, Blindern. Inst. of Aviation Medicine.

ACCIDENTS IN FIGHTER AIRCRAFT CAUSED BY HUMAN FACTORS. WHY DO THEY OCCUR

Grete Myhre *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations Jun. 1989 6 p (For primary document see N90-17275 09-53)

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Pilots in fighter aircraft represent a rigorously selected group both physically and psychologically. Still, more than half of the incidents and accidents involving these aircraft can be attributed to human factor overloading, even during routine operations. In what way is this high number of human error accidents explained, considering the fact that the psychological selection tests have never been more sophisticated and thorough than they are today. Possible reasons for and answers to this question are examined. Author

N90-17279# Aeronautical Research Inst. of Sweden, Stockholm.

PSYCHOLOGICAL REACTIONS OF PILOTS INVOLVED IN ACCIDENTS IN THE SWEDISH AIR FORCE

Kristina Pollack *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations Jun. 1989 4 p (For primary document see N90-17275 09-53)

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Every aircraft accident could be described as a unique life-event, complex in nature with varying causes and effects. Studies of the emotional consequences of accidents in military aircrew are sparse. Data obtained from pilots involved in accidents was examined to learn their psychological reactions to accidents. As a part of the air safety program in the Swedish Air Force

retrospective information was obtained from 40 pilots who had survived military aircraft crashes during 1978 to 85. In order to collect objective and subjective data all pilots completed comprehensive questionnaires covering the following areas: (1) the air crash; (2) how events happened during the ejection and the following rescue; (3) the medical consequences and the emotional sequels, i.e., reactions, thoughts and mood after survival; and (4) attitudes towards resuming flying duty. Free comments were encouraged in the responses to questions concerning desired psychological support and rehabilitation. Results are examined.

Author

N90-17280# Israeli Air Force Aeromedical Center, Tel Hashomer. Psychology and Psychiatry.

THE DESCENT FROM THE OLIMPUS: THE EFFECT OF ACCIDENTS ON AIRCREW SURVIVORS

I. Barnea *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations Jun. 1989 9 p (For primary document see N90-17275 09-53)

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Limited research has been done studying the effects of flying accidents on surviving aircrews (pilots and navigators). In general, it consists of case studies conducted by squadron medical staff focusing on serious problems developed by the pilot and/or his family as a result of the accident. The most significant finding of this research has been that the return to flying following an accident in flight is not as simple as it may appear. To consider an accident as part of the training routine and to expect return to normal activities as if nothing out of the ordinary has occurred is to ignore the legitimate emotional reactions of the aircrew and the possible effects of those reactions on the development of physical and psychological symptoms including deterioration of flying performance, motivation and commitment. Return to flying with hidden, untreated symptoms is likely to aggravate them, prolong their resolution or even make them irreversible resulting in the loss of flight personnel. Two objectives were persued: (1) to improve the understanding of the relationship between a flying accident, the resulting emotional reactions and their effect on performance levels; and (2) to develop an effective intervention procedure to enable the accident survivors to return quickly to preaccident functioning, both emotionally and professionally. Several aircrew survivors of serious flying accidents in the past five years participated in a research conducted by a psychologist using a structured interview especially developed for the present study. Results of the interview showed that 44 percent of the survivors reported a decrease in their flight performance and feeling toward flying than prior to the accident.

Author

N90-17281# Air Force Human Resources Lab., Brooks AFB, TX. Personnel Research Psychologist.

PERSONALITY CHARACTERISTICS OF USAF PILOT CANDIDATES

Frederick M. Siem *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations Jun. 1989 7 p (For primary document see N90-17275 09-53)

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To examine the utility of personality measures for enhancing current selection methods, a computerized personality inventory was administered to a sample of USAF pilot candidates prior to flying training. Analysis of the data suggested that two of five personality factors were associated with training outcomes, and that one of the measures added predictive utility to test scores currently used for pilot selection. Candidates who were self-confident and not dogmatic manifested higher graduation rates than pilot candidates who were either less self-confident or more dogmatic (less flexible in their values). For a subset of respondents, performance scores were available for two phases of training. Examination of the data indicated that personality characteristics (depression, activity level) that did not differentiate training graduates from non-graduates were associated with better performance in two phases of flight training. In contrast, characteristics on which graduates and non-graduates differed (self-confidence, values flexibility) did not appear to be associated with performance scores during training. The main conclusion from this research is personality measures can contribute predictive utility to a pilot selection system over and beyond that displayed by currently operational aptitude measures. A second conclusion is that careful consideration must be made in the selection of both predictor and criterion variables in quantifying the relationships best suited for determining operational utility of personality measures.

Author

N90-17282*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

LEADER PERSONALITY AND CREW EFFECTIVENESS: FACTORS INFLUENCING PERFORMANCE IN FULL-MISSION AIR TRANSPORT SIMULATION

Thomas R. Chidester and H. Clayton Foushee *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations Jun. 1989 9 p (For primary document see N90-17275 09-53)

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A full mission simulation research study was completed to assess the potential for selection along dimensions of personality. Using a selection algorithm described by Chidester (1987), captains were classified as fitting one of three profiles using a battery of personality assessment scales, and the performances of 23 crews led by captains fitting each profile were contrasted over a one and one-half day simulated trip. Crews led by captains fitting a Positive Instrumental Expressive profile (high achievement motivation and interpersonal skill) were consistently effective and made fewer errors. Crews led by captains fitting a Negative Communion profile (below average achievement motivation, negative expressive style, such as complaining) were consistently less effective and made more errors. Crews led by captains fitting a Negative Instrumental profile (high levels of Competitiveness, Verbal Aggressiveness, and Impatience and Irritability) were less effective on the first day but equal to the best on the second day. These results underscore the importance of stable personality variables as predictors of team coordination and performance.

Author

N90-17283# Aerospace Medical Research Labs., Wright-Patterson AFB, OH. Human Engineering Div.

REACTIONS TO EMERGENCY SITUATIONS IN ACTUAL AND SIMULATED FLIGHT

Glenn F. Wilson, June Skelly, and Bradley Purvis *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations Jun. 1989 15 p (For primary document see N90-17275 09-53)

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Four emergency situations occurred during inflight and simulated air-to-ground training missions. Heart rate data were recorded from the pilots as part of a study designed to determine the effects of mission segment and flight position. A 50 percent increase in heart rate was found to occur only during actual flight but not during simulated flight emergencies. Heart rate variability decreased in all cases but to a greater extent during the inflight emergencies.

Author

N90-17284# Illinois Univ., Urbana-Champaign. Inst. of Aviation.

EXPERTISE, STRESS, AND PILOT JUDGMENT

Christopher D. Wickens, Barbara Barnett, Alan Stokes, Tom Davis, Jr., and Fred Hyman *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations Jun. 1989 9 p (For primary document see N90-17275 09-53)

(Contract C87-101376-2)

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Two studies are described of pilot judgment, examining the effects of stress and of expertise. Both studies were carried out on a computer-based aviation decision making simulation called MIDIS. In the first study the cognitive abilities of 40 instrument rated pilots, 20 novices and 20 experts were assessed. These pilots then flew the MIDIS simulator on a simulated cross country flight during which their performance on a number of in-flight decisions was assessed. Experts were more confident than novices, but did not perform more optimally. The pattern of ability differences that predicted novice performance was different from that which predicted expert performance. In the second study, 10 instrument-rated pilots flew a different flight on MIDIS under conditions of stress (imposed by time pressure, noise, financial risk, and task loading), while 10 subjects flew in a nonstressed control condition. Stress had different effects on different kinds of decision problems. It degraded performance on those problems imposing high demand on working memory, but left unaffected those problems imposing high demand on the retrieval of facts from long term memory. The results are discussed in terms of the commonalities between the effects of expertise and stress, on the mechanisms of working memory and long term memory in pilot judgment. Author

N90-17285# Norwegian Underwater Technology Center Ltd., Laksevaag.

STRESS AND PERFORMANCE DURING A SIMULATED FLIGHT IN A F-16 SIMULATOR

Ragnar J. Vaernes, Marit Warncke, Grete Myhre, and Asbjorn Aakvaag *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations Jun. 1989 9 p Prepared in cooperation with Institute of Aviation Medicine, Oslo, Norway (For primary document see N90-17275 09-53)

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Sixteen Norwegian F-16 pilots (average age = 24.2 years, average experience = 2.2 years) were tested before, during and after a 90 min flight in a F-16 simulator. During the flight different emergency operations and landings in difficult weather conditions had to be performed. The pilot performance was logged continuously during the flight (Accepted/Not accepted). Heart rate (HR)/heart rate variability (HRV) was monitored continuously. Saliva for cortisol analysis and urine for catecholamine analysis were sampled before and after the flight. Tests of anxiety (state and trait) and defense mechanisms (Plutchik's Life Style Index, LSI) were administered. In addition to the pilots' test results on Krag's Defense Mechanism Test (DMT), results on psychomotor performance from the selection period were used. The endocrine and the HR-results indicated that the pilots were very activated during the flight. A HR of 120 beats/min was registrated. There were significant correlations between endocrine levels and not-accepted performance. Pilots with high defense mechanisms were significantly less activated on HRV, but had more pilot errors. Pilots with high defense considered simulator training as less important and they also trusted more the instruments in the aircraft. There was a significant correlation between high defense and number of near miss episodes during real flights. The results confirm previous studies which have shown that high defense correlates both to endocrine activation and impaired performance during stress in high risk occupations. Author

N90-17286# Civil Aeromedical Inst., Oklahoma City, OK.

PERFORMANCE RECOVERY FOLLOWING STARTLE: A LABORATORY APPROACH TO THE STUDY OF BEHAVIORAL RESPONSE TO SUDDEN AIRCRAFT EMERGENCIES

Richard I. Thackray *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations Jun. 1989 7 p (For primary document see N90-17275 09-53)

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The use of response/recovery to auditory startle as a laboratory technique for simulating some of the principal aspects of the initial shock phase of sudden emergency situations is examined. It is submitted that auditory startle, with its unexpectedness, pronounced autonomic reaction, fear-like subjective experience, and frequent behavioral disruption, approximates the response pattern to be expected in the initial shock phase of sudden traumatic emergencies, and that by studying the time course of performance recovery following startle, as well as individual differences in response/recovery, a better understanding may be gained of some of the variables related to extreme reactions displayed by individuals in real life emergency situations. Research studies on performance impairment/recovery following startle are reviewed. These studies include those dealing with initial reaction time to the startle stimulus itself, disruption and recovery rate of perceptual-motor (tracking) performance following startle, and the time-course of performance recovery in information processing tasks after exposure to startle. Data are also presented showing a relationship of several individual difference variables to performance response/recovery following startle. These variables include autonomic response to the startle stimulus and level of task proficiency prior to startle. Author

N90-17287# Spanish Air Force (23rd Wing), Talavera AFB.

PERIPHERAL NERVOUS VELOCITY OF CONDUCTION IN FIGHTER PILOTS

J. L. Garcia Alcon, J. M. Moreno Vazquez, J. E. Campillo Alvarez, and A. Gonzalez Roncero (National Health Inst., Badajoz, Spain) *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations Jun. 1989 7 p (For primary document see N90-17275 09-53)

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Fighter pilot is under an important stress because of his special professional activity. It origins an automatic response through neurohormonal mechanisms. The most important among these mechanisms is the catecholamins secretion. These hormones will produce very important changes in the general homeostasy. The peripheral nervous system and mainly its mielyn sheath, is highly sensitive to variations in the internal environment. When that sheath is damaged the rapidity of nervous impulse transmission decrease. The system for to know that injury, is through measuring of the nervous velocity of conduction. This work shows the abnormal behavior of sensitive nervous velocity of conduction in fighter pilots in depending of flight hours. The great consumption of oxygen could be the reason for that alteration. Authors have found an important increase in Catalase and Glutathione-Peroxidase, that enzymes are protective systems in front to oxidations. Author

N90-17288# University of Southern California, Los Angeles. Dept. of Human Factors.

TRAINING AND SELECTING INDIVIDUALS FOR HIGH LEVELS OF INFORMATION PROCESSING LOAD

Diane Damos *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations Jun. 1989 5 p (For primary document see N90-17275 09-53)

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Techniques are examined for training and selecting pilots to deal with high information processing loads. Models of human information processing are briefly reviewed, then four methods of selecting pilots who can process large amounts of information quickly are discussed. Three of these four methods (selection based on the Type A behavioral pattern, measures of specific timesharing abilities, and the specific multiple-task response strategy) are recommended either for immediate use or for more extensive evaluation. Automation, the development of timesharing skills, and the development of flexible visual scan patterns are techniques that could be used to increase a pilot's information

processing rate. None of these techniques has a basic research data base sufficient for the development of operational training techniques. All three are, however, promising and should be pursued in a systematic fashion. Author

N90-17289# Naval Aerospace Medical Research Lab., Pensacola, FL.

PERSONALITY ASSESSMENT IN AVIATION SELECTION

Daniel L. Dolgin *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations Jun. 1989 7 p (For primary document see N90-17275 09-53)

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A comprehensive review of the personality literature as it relates to aircrew selection was conducted. The purpose was to identify specific tests that warrant further research as potential prediction instruments. Aviation selection techniques in the U.S. Navy and U.S. Air Force were reviewed. Individual tests used in aviation selection are discussed in terms of their results. The advent of performance-based personality assessment in the 1970s is examined, and implications for future test development are explored. The majority of personality instruments reviewed were invalid for pilot selection. In some cases, methodological difficulties may have obviated more promising results. Recommendations are made for continued research with several tests that appear to be both effective in pilot selection and psychometrically sound. Those recommended selection tests include the Defense Mechanism Test because of its effectiveness in predicting pilot training success and safety in the Swedish and Danish forces. The Personality Research Form is recommended due to both its psychometric construction and current research efforts that are ongoing in the Canadian Armed Forces and U.S. Air Force. The Locus of Control is also proposed for both closer and continued attention. Other recommended selection instruments include the Work and Family Orientation Questionnaire and Extended Personality Attributes Questionnaire. Safety in aviation is also addressed as a major, emerging area of interest in the 1980s. Author

N90-17290# Bergen Univ. (Norway). Dept. of Physiological Psychology.

ACTIVATION: POSITIVE AND NEGATIVE EFFECTS OF THE ALARM SYSTEM IN THE BRAIN

Holger Ursin *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations Jun. 1989 11 p (For primary document see N90-17275 09-53)

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There is hardly any human activity where the level of wakefulness may have so dramatic effects on performance with consequences for life and death, as aviation and other forms of rapid transportation. All aspects of the problem area seem to be present: boredom and lack of attention during long periods of routine operation, bursts of activity at top performance level, and the possibility that there are long term effects which may be harmful in the long run. Numerically land transport is by far the most dangerous and costly operation, counted in lives lost or invalids produced. However, the concern herein is aviation, but the factors involved are general psychological and physiological principles valid for many types of activity. The mechanisms are actually biologically general as well, and some of the relevant data derive from animal experimentation. The mechanisms are examined in detail. Author

N90-17291# Ministry of Defence, London (England).

THE TRIALS AND TRIBULATIONS OF RAF DEFENCE MECHANISM TESTING

G. J. Walker-Smith *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations Jun. 1989 6 p (For primary document see N90-17275 09-53)

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The Defense Mechanism Test (DMT) is a projective personality test that was devised in Sweden, in the 1950s. It was designed to identify how individuals cope with a threat and to assess what defence mechanisms are used to protect the individual in a stressful situation. Swedish validity studies have shown that the DMT can predict training wastage and pilot error flying accidents. Consequently the DMT has been used for pilot selection. The test has also been used for Air Force pilot selection in Norway, Denmark, Greece and the Netherlands and is undergoing trials in other countries. Since 1976 empirical investigations have been carried out to test the validity of using the DMT to select Royal Air Force (RAF) pilots. Owing to methodological inadequacies, early RAF trials proved inconclusive. However, in 1984 a DMT trial was set up where the Swedish method of testing was followed. DMT scores were collected from a sample of 253 pilot trainees and their flying training results and flying accident involvement are being monitored. So far this DMT trial has shown that the DMT scores fail to predict flying training performance. The discrepancy between the RSwAF results and the RAF findings is considered. Author

N90-17292# Institut d'Aeronomie Spatiale de Belgique, Brussels.

PRINCIPLE GUIDELINES FOR THE PSYCHOLOGICAL SCREENING OF CANDIDATE PILOTS FOR THE BELGIAN AIR FORCE [LIGNES DIRECTRICES PRINCIPALES FONDANT LA SELECTION PSYCHOLOGIQUE DES CANDIDATS PILOTES A LA FORCE AERIENNE BELGE]

J-C. Genon and P. Vanderbosch (Belgian Air Force, Brussels.) *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations Jun. 1989 5 p In FRENCH (For primary document see N90-17275 09-53)

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Various psychological testing and screening methods employed by the Belgian Air Force for the selection of pilots are described. Emphasis is given to the description of guidelines for the candidate selection process. Selection criteria, interpretation of results, functional models, and the use of simulation are also addressed. Transl. by M.G.

N90-17293# Institute for Perception RVO-TNO, Soesterberg (Netherlands).

PREDICTION OF SUCCESS IN FLIGHT TRAINING BY SINGLE- AND DUAL-TASK PERFORMANCE

P. G. A. M. Jorna *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations Jun. 1989 10 p (For primary document see N90-17275 09-53)

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Advanced technology has changed the type and the amount of information a pilot has to process. The military pilot is particularly involved in performing multiple tasks under difficult working conditions. Some aspirant pilots are not able to finish advanced training, apparently for reasons of an insufficient multiple task performance. A reduction of such attrition is highly desirable to reduce the cost of training. A test based on dual-task performance was developed to investigate the trainability of aspirant pilots to perform under such demanding conditions. The dual-task was a combination of a pursuit tracking task with preview and a continuous memory task (CMT). Aspirant pilots practiced the tracking task and were tested under single- and dual-task conditions. Dual-task performance was expected to be related to pilot aptitude as assessed by other criteria. The results were validated against the level of pilot aptitude as assessed by traditional selection procedures, a flight simulator test and advanced flight training for the Lockheed Orion and the Westland Lynx helicopter. Successful aspirants, now operational pilots, were characterized by their excellent performance under dual-task conditions. Less successful

aspirants performed less efficient under dual-task conditions as well as single-task conditions, depending on how soon they failed in the selection and training process. Prior flying experience did not influence tracking performance and was not found to be a critical factor in predicting success in advanced or operational flight training. Author

N90-17294# Naval Aerospace Medical Research Lab., Pensacola, FL.
PREDICTING AIR COMBAT MANEUVERING (ACM) PERFORMANCE
G. R. Griffin *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations Jun. 1989 13 p (For primary document see N90-17275 09-53)
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A difficult aspect of predicting fleet pilot performance is acquiring meaningful and reliable, inflight criteria. Air Combat Maneuvering (ACM) performance was provided using performance-based laboratory tests and the VF-43 adversary squadron's grading of inflight ACM performance was evaluated in the Fleet Fighter ACM Readiness Program. In an initial evaluation, F-4 pilots performed in Fleet Fighter ACM Readiness exercises and completed performance-based perceptual motor and multitask tests. Results indicated that dichotic listening test measures, obtained during multitask conditions, could be used to reliably predict ACM inflight criteria. Results assigned by VF-43 adversary personnel can be predicted reliably by an objective kill difference composite score and three subjective measures: situational awareness, mutual support, and energy management. These measures accounted for 78 percent of the variance with the OAG. A correlational analysis suggests that the VF-43 grading process is reliable and consistent. Author

N90-17295# Institute for Perception RVO-TNO, Soesterberg (Netherlands).
STANDARDIZED TESTS FOR RESEARCH WITH ENVIRONMENTAL STRESSORS: THE AGARD STRES BATTERY
L. C. Boer, E. W. Farmer, and Glenn F. Wilson (Aerospace Medical Research Labs., Wright-Patterson AFB, OH.) *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations Jun. 1989 16 p (For primary document see N90-17275 09-53)
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Assessment of human cognitive performance under stress is highly desirable, but is hampered by lack of standardization. Most tasks used in stress research are based on the paradigms of Human Performance Theory, that are frameworks for the manipulation of variables, not yardsticks for assessing stressor effects. In consequence, the results of two different studies cannot be compared directly. Even if the studies used the same paradigm, the particular task may have differed on such variables as condition of testing, number of trials, amount of training, or type of stimuli. Thus, for applied work there is a need for standardization. The AGARD STRES battery (Standardized Tests for Research with Environmental Stressors) is described as proposed by AGARD. The battery consists of seven tasks based on widely-used paradigms. The seven tasks and a data-exchange format are described. Author

N90-17296# Environmental Research Inst. of Michigan, Ann Arbor.
SURVEY OF ERIM APPROACHES APPLICABLE TO SEMI-AUTOMATIC TARGET DETECTION AND CUEING FOR MULTISPECTRAL AND MULTISENSOR EXPLOITATION Final Report
Lynnette Wood 25 Jul. 1989 80 p Sponsored by RADC Prepared for Pattern Analysis and Recognition Corp., New Hartford, NY
(Contract SC-88-0151-02)
(AD-A214241; ERIM-215400-1-F) Avail: NTIS HC A05/MF A01 CSCL 17/8

Tactical and strategic decisions must increasingly be made based on the aggregation and integration of information from various sources. Multiple sensors can be employed to provide a range of parameters which can aid in identifying enemy targets. The synergistic combination of data from these various sensors, as well as from other sources, can enhance a photointerpreter's ability to locate and identify targets. A semi-automatic multispectral multisensor system for target detection would be invaluable for this purpose. The Semi-Automated Multispectral/Multisensor Exploitation (SAMME) Project is an effort to develop computer assisted algorithms and display methods to aid interpreters in identifying targets in multispectral multisensor data. This report outlines approaches attempted at the Environmental Research Institute of Michigan (ERIM) which are relevant to the SAMME project. A series of over 200 ERIM documents were reviewed. Included in the review were internal memos, technical reports, white papers, proposals and journal articles published by ERIM employees which describe results of work done at ERIM. The report includes information on benefits and drawbacks of various approaches under different circumstances. However, this report is not a recommendation for a particular system, only a compendium of knowledge applicable to the task. GRA

N90-17297# Northeastern Univ., Boston, MA. Dept. of Psychology.
A MODEL FOR VISUAL ATTENTION Final Technical Report, 31 Jul. 1988 - 31 Jul. 1989
Adam Reeves 1 Oct. 1989 4 p
(Grant AF-AFOSR-0172-87; AF Proj. 2313)
(AD-A214505; AFOSR-89-1322TR) Avail: NTIS HC A01/MF A01 CSCL 06/4

Research has been undertaken in three areas concerning human visual attention: the AGM model for attention shifting, iconic memory and visual imagery. GRA

N90-17298# Pittsburgh Univ., PA. Learning Research and Development Center.
FEEDBACK EFFECTS IN COMPUTER-BASED SKILL LEARNING Final Report, 1986 - 1989
John M. Levine and Walter Schneider 12 Sep. 1989 69 p
(Contract N00014-86-K-0569; RR04206)
(AD-A214560) Avail: NTIS HC A04/MF A01 CSCL 05/6

This paper reports several experiments that investigated how performance feedback in a computer-based training environment affected students' acquisition of cognitive skills requiring substantial practice. College students worked on category-search or electronic troubleshooting tasks; problems were presented, responses were recorded, and performance feedback was given using microcomputer. We studied the impact of receiving information about: (1) temporal trends in one's own performance (i.e., intrapersonal feedback alone), and (2) temporal trends in both one's own and others' performance (i.e., joint intrapersonal and interpersonal feedback). In regard to intrapersonal feedback alone, we assessed how different types of absolute performance information (e.g., weighted vs. unweighted averages of reaction times on previous trials) affected students' learning. Results indicated that these manipulations had only weak effects. In regard to joint intrapersonal and interpersonal feedback, we assessed how different types of relative performance information (e.g., superiority vs. inferiority vis-a-vis others) affected students' learning. Here, evidence revealed that the type of feedback students received influenced how well they performed. It was suggested that the impact of intrapersonal and intrapersonal feedback will be affected by the amount of practice time needed to achieve proficiency. GRA

N90-17299# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
COMPLEXITY OF HUMAN LANGUAGE COMPREHENSION
Eric S. Ristad Dec. 1988 50 p

(Contract N00014-85-K-0124)
(AD-A214591; AI-M-964) Avail: NTIS HC A03/MF A01 CSCL 05/7

The goal of this research has been to understand the computational structure of principle-and-parameter linguistic theories: what computational problems do these theories pose and what is the underlying structure of those computations. The computational problem of human language comprehension is analyzed: what linguistic representation is assigned to a given sound. This language comprehension problem may be factored into smaller, interrelated (but independently stable) problems defined on partial phonological, morphological, and syntactic representations. For example, in order to understand a given sound, the listener must assign a phonetic form to the sound; determine the morphemes that compose the words in the sound; and calculate the linguistic antecedent of every pronoun in the utterance. The author proves that these and some other subproblems are all NP-hard, and that language comprehension is itself PSPACE-hard, according to current linguistic theory. GRA

N90-17300# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
THE PERCEPTUAL BUILDUP OF THREE-DIMENSIONAL STRUCTURE FROM MOTION
Ellen C. Hildreth, Norberto M. Grzywacz, Edward H. Adelson, and Victor K. Inada Aug. 1989 37 p
(Contract N00014-85-K-0124)
(AD-A214640; AI-M-1141; CBIP-M-20) Avail: NTIS HC A03/MF A01 CSCL 05/8

A set of psychophysical experiments that measure the accuracy of perceived 3-D structure derived from relative motion in the changing 2-D image is presented. The experiments are motivated in part by a computational model proposed by Ullman (1984), called the incremental rigidity scheme, in which an accurate 3-D structure is built up incrementally, by considering images of moving objects over an extended time period. The main conclusions are: (1) the human visual system can derive an accurate model of the relative depths of moving points, even in the presence of noise in their image positions; (2) the accuracy of the 3-D model improves with time, eventually reaching a plateau; and (3) the 3-D structure currently perceived appears to depend on previous 3-D models. Through computer simulations, the results are related of the psychophysical experiments with the predictions of Ullman's model. GRA

N90-17301# Naval Aerospace Medical Research Lab., Pensacola, FL.
DEVELOPMENT OF A PERFORMANCE-BASED TEST OF GAZE CAPABILITY: A THRESHOLD APPROACH Interim Report, Oct. 1986 - Oct. 1988
W. Carroll Hixon 16 Oct. 1989 21 p
(AD-A214675; NAMRL-1345) Avail: NTIS HC A03/MF A01 CSCL 06/4

A high degree of gaze efficiency involving the precise coordinated motion of the head and eyes is particularly important to the aviator when making large shifts in gaze during the visual scan of cockpit instruments and avionics systems. For this reason, NAMRL has concentrated on the development of a relatively low-cost, performance-based measure of head/eye coordination that can be used to identify individual differences in the naval aviation population. Preliminary research has led to the development of a simplified test of gaze function identified as the Vestibulo Ocular-Reflex Performance Test (VORPET). The test is based on a Bekesy-type determination of the threshold time required for an individual to recognize and identify a fixed number of digits immediately following 90 deg shifts in gaze. The report provides a detailed description of the new test protocol and its design concepts along with the results of experiments comparing horizontal and vertical gaze shift performance, and test-retest learning effects. GRA

N90-17302# George Mason Univ., Fairfax, VA. Dept. of Psychology.
RECOGNITION OF ENVIRONMENTAL SOUNDS Final Report, 1 Jun. 1987 - 30 Jun. 1989
James A. Ballas Nov. 1989 16 p
(Contract N00014-87-K-0167)
(AD-A214942; ONR-TR-89-1) Avail: NTIS HC A03/MF A01 CSCL 23/2

The studies focused on two areas: acoustic and perceptual-cognitive factors related to sound identification; and the effects of context on identification of specific sounds. Results indicated that identification time and accuracy are related to causal uncertainty and to a construct called identifiability. Context was found to produce negative bias but not positive bias. GRA

N90-17303# Arizona Univ., Tucson. Dept. of Psychology.
MEASURES OF SUBJECTIVE VARIABLES IN VISUAL COGNITION Annual Report, 1 Sep. 1988 - 30 Sep. 1989
Mary A. Peterson 30 Sep. 1989 120 p
(Grant AF-AFOSR-0075-89; AF Proj. 2313)
(AD-A215084; AFOSR-89-1489TR) Avail: NTIS HC A06/MF A01 CSCL 05/8

A series of 10 experiments examined the subjective variables involved in the perceptual organization of shapes and objects; in particular, the role played by: (1) perceptual intentions, (2) structural knowledge, and (3) spatial attention. A series of experiments identified functional consequences of structural knowledge in both perception and imagery and functional differences between the two types of perceptual selectivity we examined. We found that: (1) prototypical shapes are perceived faster than quasitypical shapes (the goodness of the set between structural representations and these two types of shapes was assumed to differ), (2) structural knowledge regarding shape components is a necessary requirement for imagery reversal, (3) perceptual intentions are more effective when directed to prototypical rather than nonprototypical shapes, implicating structural knowledge as a mechanism through which perceptual intentions operate, and (4) spatial attention can be directed to parts of objects whereas perceptual intentions may operate holistically. In addition, the experiments provided some evidence that multiple shape representations are activated prior to shape recognition, and led to a new model of figure-ground organization. GRA

N90-17304# Kansas Univ., Lawrence. Dept. of Psychology.
MEASURING LEARNING ABILITY BY DYNAMIC TESTING Final Report, 1 Aug. 1988 - 31 Jul. 1989
Susan Embretson 30 Sep. 1989 185 p
(Grant AF-AFOSR-0242-88; AF Proj. 2313)
(AD-A215273; AFOSR-89-1511TR) Avail: NTIS HC A09/MF A01 CSCL 05/8

A criticism of traditional ability tests is that they are static, rather than dynamic, measures of intelligence. That is, the tests measure what the person has learned, but not necessarily the capacity to learn. This project developed two tests of learning ability, spatial learning ability and mathematical learning ability, based on cognitive theory. In these tests which consist of a pretest and two posttests, learning ability is the modifiability of a person's performance under conditions that change the cognitive load of the task, such as strategy training or cues. To solve some psychometric problems in measuring change (i.e., the inequivalencies of raw change at different initial performance levels and the unreliability of change scores), the multidimensional Rasch model for learning and change (Embretson, 1987; 1989A; 1989b) was used to estimate learning abilities. Further, the tests were counterbalanced for the stimulus features that influence processing difficulty to assure cognitive equivalency and to observe the impact of strategy training and cues on the mental models used in the tasks. Three goals were accomplished for each test: large sample data was obtained to calibrate the tests by the multidimensional Rasch model for learning and change, the construct validity of the learning ability measurements was examined and the cognitive theory underlying the tasks in each test was extended. GRA

N90-17305# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
STIMULUS FAMILIARITY DETERMINES RECOGNITION STRATEGY FOR NOVEL 3-D OBJECTS
Shimon Edelman, Heinrich Bulthoss, and Daphna Weinshall Jul. 1989 23 p
(Contracts N00014-88-K-0164; DACA76-85-C-0010)
(AD-A215274; AI-M-1138; CBIP-M-40) Avail: NTIS HC A03/MF A01 CSCL 06/4

Everyday objects are more readily recognized when seen from certain representative, or canonical, viewpoints than from other, random, viewpoints. We investigated the canonical views phenomenon for novel 3-D objects. In particular, we looked for the effects of object complexity and familiarity on the variation of response times and error rates over different views of the object. Our main findings indicate that the response times for different views become more uniform with practice, even though the subjects in our experiments received no feedback as to the correctness of their responses. In addition, the orderly dependency of the response time on the distance to a good view, characteristic of the canonical views phenomenon, disappears with practice. One possible interpretation of our results is in terms of a tradeoff between memory needed for storing specific-view representations of objects and time spent in recognizing the objects. GRA

N90-17306# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
PAYLOAD INVARIANT CONTROL VIA NEURAL NETWORKS: DEVELOPMENT AND EXPERIMENTAL EVALUATION M.S. Thesis
Mark A. Johnson Dec. 1989 157 p
(AD-A215740; AFIT/GE/ENG/89D-20) Avail: NTIS HC A08/MF A01 CSCL 12/9

One problem in robot control is how to obtain accurate high speed trajectory tracking when the payload varies throughout the performance of the task. A solution to the problem is one requirement for realizing a manipulator capable of duplicating human performance. A manipulator with the ability to emulate human performance is one prerequisite for achieving Air Force Robotic Telepresence program objectives. A new form of adaptive model-based control is proposed and experimentally evaluated. An Adaptive Model-Based Neural Network Controller (AMBNNC) uses multilayer perceptron artificial neural networks to estimate the payload during high speed manipulator motion. The payload estimate adapts the feedforward compensator to unmodeled system dynamics and payload variations. The neural nets are trained through repetitive training on trajectory tracking error data. The AMBNNC is experimentally evaluated on the third link of a PUMA-560 manipulator. Tracking performance is evaluated for a wide range of payload and trajectory conditions and compared to a non-adaptive model-based controller. The superior tracking accuracy of the AMBNNC demonstrates the potential of the proposed technique. GRA

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

N90-17307# Texas A&M Univ., College Station. Dept. of Industrial Engineering.
INVESTIGATION OF THE EFFECTS OF EXTERNAL SUPPORTS ON MANUAL LIFTING Ph.D. Thesis
Alfred Alan Amendola May 1989 126 p Sponsored by National Inst. for Occupational Safety and Health, Cincinnati, OH
(PB90-103367) Avail: NTIS HC A07/MF A01 CSCL 05H

The study was conducted to assess the utility of the use of external support devices for manual lifting. Two commercially available devices, an airbelt and a compvest, and a combination of the two devices were tested in a lifting experiment for three frequencies of lift (three, six, and nine lifts per minute) using 20 male university student volunteers. The lifts were also performed with no device. The subjects lifted a tote box containing steel and lead shot from the floor to Metacarpal-3 height at various rates of lift and with different support devices for two 20 minute sessions. Four independent methods were used in the evaluation: biomechanical, psychophysical, subjective survey, and body part discomfort. No device was significantly different from the control condition for the maximum acceptable weight of lift over all the participants. No significant differences were noted in the compressive force in the low back among the device treatments. No preference was determined subjectively for any specific device. No significant differences were noted based on body part discomfort measurements. It was concluded from the study that the use of lifting devices is questionable as an aid in lifting. GRA

N90-17308*# Southern California Inst. of Architecture, Santa Monica.
SPACE STATION WARDROOM HABITABILITY AND EQUIPMENT STUDY
David Nixon, Christopher Miller, and Regis Fauquet Washington NASA Dec. 1989 142 p
(Contract NCC2-356)
(NASA-CR-4246; NAS 1.26:4246) Avail: NTIS HC A07/MF A01 CSCL 06K

Experimental designs in life-size mock-up form for the wardroom facility for the Space Station Habitability Module are explored and developed. In Phase 1, three preliminary concepts for the wardroom configuration are fabricated and evaluated. In Phase 2, the results of Phase 1 are combined with a specific range of program design requirements to provide the design criteria for the fabrication of an innovative medium-fidelity mock-up of a wardrobe configuration. The study also focuses on the design and preliminary prototyping of selected equipment items including crew exercise compartments, a meal/meeting table and a portable workstation. Design criteria and requirements are discussed and documented. Preliminary and final mock-ups and equipment prototypes are described and illustrated. Author

N90-17309# Illinois Univ. at Urbana-Champaign, Savoy. Aviation Research Lab.
PROXIMITY COMPATIBILITY AND INFORMATION DISPLAY: THE EFFECTS OF SPACE AND COLOR ON THE ANALYSIS OF AIRCRAFT STALL CONDITIONS Final Report
Anthony D. Andre and Christopher D. Wickens Oct. 1989 45 p
(Contract DAAA15-86-K-0013; DA Proj. 1L1-61102-B-74-A)
(AD-A214488; HEL-TM-16-89) Avail: NTIS HC A03/MF A01 CSCL 23/2

The proximity compatibility principle (Wickens, 1987) asserts that when a task requires the integration of multiple sources of information, performance will be best supported when that information is displayed in close proximity. Conversely, when a task requires attention to be focused on a specific source of information, performance will be best supported by a more separated display. To assess the validity of this principle, a series of three experiments were conducted in which subjects monitored a display of flight parameters critical to aircraft stability and were required to either predict the likelihood of an aircraft stall (information integration) or to recall the value of a single flight parameter (focused attention). Display proximity of relevant information was imposed through spatial closeness and color similarity. The results indicate that color adheres to the proximity compatibility principle, but that space does not. Instead, the spatial proximity between relevant and irrelevant information appears to be the dominant factor affecting performance across both tasks. The data are discussed in terms of their practical implications for multi-element display design. GRA

N90-17310# School of Aerospace Medicine, Brooks AFB, TX.
PRESCRIBING SPECTACLES FOR AVIATORS Final Report, Sep. 1988 - Sep. 1989

Robert E. Miller, II, John F. Kent, and Robert P. Green, Jr. Sep. 1989 36 p
(AD-A214830; USAFSAM-SR-89-5) Avail: NTIS HC A03/MF A01 CSCL 06/5

This special report was written as a review and reference for USAF vision specialists in prescribing spectacles for aviators. Vision correction in flyers presents unique problems especially for the presbyopes. The demands of each individual aircraft environment need to be well understood. USAF ophthalmologists and optometrists must consider the pertinent aeromedical factors before prescribing spectacles for ametropic aircrew members. This report includes a comprehensive guide to cockpit instrument panel distances and print sizes for most USAF aircraft. GRA

N90-17311# Air Force Medical Center, Wright-Patterson AFB, OH.
ATTENUATING THE LUMINOUS OUTPUT OF THE AN/PVS-5A NIGHT VISION GOGGLES AND ITS EFFECTS ON VISUAL ACUITY Final Report
Richard R. Levine and Charence E. Rash Sep. 1989 36 p
(AD-A214895; USAARL-89-24) Avail: NTIS HC A03/MF A01 CSCL 20/6

Aviators in combat may be subjected to a variety of noxious light stimuli. Filters and other eye protective devices may be used to counter these threats. At night, filters may be used in conjunction with image intensification devices (e.g., night vision goggles) to provide useful low-light vision as well as protection from deleterious light sources (e.g., lasers, pyrotechnics, nuclear fireballs, etc.). Technologies may be combined in a single, integrated head gear unit. The present study was performed in order in consider the effects on visual acuity after reducing night vision goggle luminous output from 0 to 99 percent. A range of target contrasts and ambient illumination levels was investigated. AN/PVS-5A goggles were selected based upon their compatibility with current phosphor display technology and their current ubiquity within aviation units. Visual acuity was assayed behaviorally because of its critical importance in flying performance. The results of the study provide normative acuity data with goggles alone and document the effects on goggle visual acuity with reduced goggle luminances as might be produced by protective materials placed between the goggles and the eyes. GRA

N90-17312# Aerospace Medical Research Labs., Wright-Patterson AFB, OH.
SUBJECTIVE WORKLOAD ASSESSMENT TECHNIQUE (SWAT): A USER'S GUIDE Interim Report, Jun. 1986 - Oct. 1988
Scott S. Potter, Jeine R. Bressler (Systems Research Labs., Inc., Dayton, OH.), and Gary B. Reid Jul. 1989 118 p
(Contract F33615-85-C-0541; AF Proj. 7184)
(AD-A215405; AAMRL-TR-89-023) Avail: NTIS HC A06/MF A01 CSCL 05/8

This report serves as a user's guide to accompany software Version 3.1 for the Subjective Workload Assessment Technique (SWAT), a tool for measuring mental workload. The guide was developed as a how-to manual for implementing SWAT. A general overview of workload is presented, all aspects of the scale development phase are described in detail, general information relating to the event scoring phase and development phase is provided, information relating to the event scoring phase is provided, and finally, each menu and screen of the program is explained step by step. Various topics are covered including descriptions of the three SWAT dimensions, use of conjoint measurement and scaling, card sort procedures and analysis, methods of prototyping, event scoring, and data analysis. Each how-to section that the user will need is provided in an appendix so that the appropriate section can be separated from the rest of the report for handy reference. GRA

N90-17313# Army Research Inst. of Environmental Medicine, Natick, MA.
PHYSIOLOGICAL EVALUATION OF MEN WEARING THREE DIFFERENT TOXICOLOGICAL PROTECTIVE SYSTEMS
Leslie Levine, Bruce S. Cadarette, Michael N. Sawka, and Kent B. Pandolf Aug. 1989 12 p
(AD-A215527) Avail: NTIS HC A03/MF A01 CSCL 15/6

This study examined the physiological responses of seven volunteers exercising in the heat while wearing three different toxicological protective systems. The Toxicological Agent Protective (TAP) suit has been available for use for more than 30 years while the other two protective systems are developmental efforts. The Self-Contained Toxicological Environmental Protection Outfit (STEPO) includes either a backpack-rebreather (with CO2 scrubber) and ice-cooling vest (STEPO-R), or a tether system which supplies breathing/cooling air inside the suit (STEPO-T). After the volunteers were heat acclimated, the three toxicological protection systems were evaluated utilizing a counter-balanced experimental design initially in a hot and then in a cool environment while subjects walked at 1.12 m/s, 0 percent grade for an attempted two hours. There was no statistical advantage of any one system in terms of exercise time in the cool environment. While evaporated sweating rate was greater for the STEPO-T in the cool environment compared to both STEPO-R and TAP. Development efforts to improve the STEPO system designs continue, and physiological evaluation of new developmental models is underway. GRA

N90-17314# Technische Univ., Berlin (Germany, F.R.). Bereich Flugfuehrung und Luftverkehr.
CHECKLIST READING PROBLEMS IN AIRPLANES EQUIPPED WITH SPEECH RECOGNITION SYSTEMS [ZUR PROBLEMATIK DES CHECKLISTENLESENS IN VERKEHRSFLUGZEUGEN UNTER ZUHILFENAHME VON SPRACHMODULEN]
Henrich Mensen and Thilo Liebig Jul. 1989 125 p In GERMAN
(ILR-Mitt-223(1989); ETN-90-96181) Avail: NTIS HC A06/MF A01

The use of speech recognition systems to help pilots control and keep track of ever more complicated flight management systems is outlined. A hydraulic system leak or loss checklist is used as a model of interactions of pilot and computer via a speech recognition system. Details of the computer control system used and the pilot/computer interface are outlined. Simulation of an emergency hydraulic leak situation is presented to illustrate the practical parameters involved in such a system. ESA

N90-17315# Oak Ridge National Lab., TN. Center for Engineering Systems Advanced Research.
JOB PLANNING AND EXECUTION MONITORING FOR A HUMAN-ROBOT SYMBIOTIC SYSTEM
Lynne E. Parker Nov. 1989 32 p
(Contract DE-AC05-84OR-21400)
(DE90-004464; ORNL/TM-11308; CESAR-89/34) Avail: NTIS HC A03/MF A01

The human-robot symbiosis concept has the fundamental objective of bridging the gap between fully human-controlled and fully autonomous systems to achieve true human-robot cooperative control and intelligence. Such a system would allow improved speed, accuracy, and efficiency of task execution, while retaining the human in the loop for innovative reasoning and decision-making. Earlier research has resulted in the development of a robotic system architecture facilitating the symbiotic integration of teleoperative and automated modes of task execution. This architecture reflects a unique blend of many disciplines of artificial intelligence into a working system, including job or mission planning, dynamic task allocation, human-robot communication, automated monitoring, and machine learning. This report focuses on two elements of this architecture: the Job Planner and the Automated Monitor. DOE

55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

N90-17316*# National Aeronautics and Space Administration, Washington, DC.
PUBLICATIONS OF THE EXOBIOLOGY PROGRAM FOR 1988: A SPECIAL BIBLIOGRAPHY
Feb. 1990 53 p Prepared in cooperation with George Washington Univ., Washington, DC
(NASA-TM-4169; NAS 1.15:4169) Avail: NTIS HC A04/MF A01 CSCL 06B

The 1988 publications resulting from research pursued under the auspices of NASA's Exobiology Program are listed. The Exobiology Program is an integrated program designed to investigate those processes that may have been responsible for or related to the origin, evolution, and distribution of life in the universe. Research supported by this program is in the areas of cosmic evolution of biogenic compounds, prebiotic evolution, early evolution of life, and evolution of advanced life. Pre-mission and pre-project activities supporting these areas are included in the areas of solar system exploration and the search for extraterrestrial intelligence. A planetary protection subject area is also included because of its direct relevance to the Exobiology program.
Author

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

N90-17317*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
EFFICIENT ALGORITHMS FOR DILATED MAPPINGS OF BINARY TREES Final Report
M. Ashraf Iqbal (University of Engineering and Technology, Lahore, Pakistan) Jan. 1990 42 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-181980; NAS 1.26:181980; ICASE-90-6) Avail: NTIS HC A03/MF A01 CSCL 12A

The problem is addressed to find a 1-1 mapping of the vertices of a binary tree onto those of a target binary tree such that the son of a node on the first binary tree is mapped onto a descendent of the image of that node in the second binary tree. There are two natural measures of the cost of this mapping, namely the dilation cost, i.e., the maximum distance in the target binary tree between the images of vertices that are adjacent in the original tree. The other measure, expansion cost, is defined as the number of extra nodes/edges to be added to the target binary tree in order to ensure a 1-1 mapping. An efficient algorithm to find a mapping of one binary tree onto another is described. It is shown that it is possible to minimize one cost of mapping at the expense of the other. This problem arises when designing pipelined arithmetic logic units (ALU) for special purpose computers. The pipeline is composed of ALU chips connected in the form of a binary tree. The operands to the pipeline can be supplied to the leaf nodes of the binary tree which then process and pass the results up to their parents. The final result is available at the root. As each new application may require a distinct nesting of operations, it is useful to be able to find a good mapping of a new binary tree over existing ALU tree. Another problem arises if every distinct required binary tree is known beforehand. Here it is useful to hardwire the pipeline in the form of a minimal supertree that contains all required binary trees.
Author

N90-17318*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
SUPPORTING SHARED DATA STRUCTURES ON DISTRIBUTED MEMORY ARCHITECTURES Final Report
Charles Koelbel, Piyush Mehrotra (Purdue Univ., West Lafayette, IN.), and John VanRosendale Jan. 1990 20 p Submitted for publication
(Contracts NAS1-18605; N00014-88-M-0108)
(NASA-CR-181981; NAS 1.26:181981; ICASE-90-7) Avail: NTIS HC A03/MF A01 CSCL 12A

Programming nonshared memory systems is more difficult than programming shared memory systems, since there is no support for shared data structures. Current programming languages for distributed memory architectures force the user to decompose all data structures into separate pieces, with each piece owned by one of the processors in the machine, and with all communication explicitly specified by low-level message-passing primitives. A new programming environment is presented for distributed memory architectures, providing a global name space and allowing direct access to remote parts of data values. The analysis and program transformations required to implement this environment are described, and the efficiency of the resulting code on the NCUBE/7 and IPSC/2 hypercubes are described.
Author

60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

N90-17319# Texas Univ., Austin. Center for Cybernetic Studies.
COMMUNICATION-EFFICIENT ARBITRATION MODELS FOR LOW-RESOLUTION DATA FLOW COMPUTING
Camille C. Price (Austin State Univ., TX.) and A. Charnes Dec. 1988 36 p
(Contracts N00014-81-C-0236; N00014-82-K-0295; NSF SES-84-08134; NSF SES-85-20806)
(AD-A214768; CCS-RR-630) Avail: NTIS HC A03/MF A01 CSCL 12/7

Low resolution data flow computing offers a practical compromise between conventional control flow computing models and the specialized architectures required for fine grain data flow processing. A formal specification is given of an arbitration facility that simultaneously partitions and statically assigns operations to processors. This general model is based on differences in the processors, diversity of data links in the network, size of tokens flowing between nodes in the data flow graph, memory limitations on the processors, and considerations to promote parallelism. A network model solves the static problem for bipartite and tree structured data flow graphs. Based on this centralized static allocation scheme, data tokens are automatically routed to processors, and the run-time scheduling process is distributed among the processors. Dynamic arbitration implemented as a centralized facility inadequate advantage of network capabilities. A general decentralized (distributed) dynamic arbitration scheme maps tasks to processors at run-time, with the association of tasks to processors based on intertask communication and network data link characteristics. Task migration is supported by treating both data and code as tokens. No centralized control or mass storage are required in this communication-efficient arbitration model.
GRA

N90-17320# Carnegie-Mellon Univ., Pittsburgh, PA. Communications Design Center.
EXECUTIVE SUMMARY FOR DESIGNING ONLINE HELP SYSTEMS: REPORT OF YEAR 1 ACTIVITY Interim Report, 4 Apr. 1987 - 30 Nov. 1988
Thomas M. Duffy, James Palmer, Brad Mehlenbacher, Guojun Zhang, and Ann Aaron 30 Nov. 1988 48 p
(Contract DAAA15-86-K-0019)
(AD-A214811; HEL-CR-8-89) Avail: NTIS HC A03/MF A01 CSCL 12/6

Interactive computer systems were once used by highly-trained specialists. Today, complex computer systems are used by people with varying levels of skill and experience. Adequate on-line help

systems must be designed so new or infrequent users will be able to effectively use the systems without lengthy training or experimentation. The purpose of this project was to perform a systematic investigation of on-line help and to develop guidelines for the design of on-line help systems for interactive computer systems. Three topics were hypothesized and investigated: (1) The help database should be arranged so that it can be efficiently maintained without sacrificing the capacity for many kinds of access and it should appear consistently so that entries can be added or amended easily. Alternate organizational strategies that balanced user-friendliness with ease of maintenance were developed and tested. (2) Each entry in the database should be structured for effective scanning and interpretation. Alternate presentation formats for on-line help information were evaluated. Optimal display strategies are reported. (3) The type of information in the data base should be specific to the users for which the on-line help system is designed. Procedures for assessing the kinds of information that will be useful were developed. Access channels to the on-line help database were designed. GRA

N90-17321# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
SATOOL II: AN IDEF0 SYNTAX DATA MANIPULATOR AND GRAPHICS EDITOR M.S. Thesis
Nealon F. Smith Dec. 1989 90 p
(AD-A215289; AFIT/GCE/ENG/89-8) Avail: NTIS HC A05/MF A01 CSCL 12/5

SAtool II, designed for use during the requirements analysis phase of software life cycle, allows users to construct structured analysis diagrams using a computer instead of manual techniques. From the graphics and data entered into the computer, data dictionary information can be derived and stored. Combined, diagrams and data dictionaries provide an effective means to depict software system development information. The tool is based on the IDEF sub 0 syntax which is a derivation of the Structured Analysis Design Technique (SADT) and was implemented using the Ada language. Development of the data model (data manipulator) was the primary focus of this thesis. The data manipulator provides all of the necessary operations to create, edit, and store data dictionary entries for the activity and data element structures of the IDEF sub 0 language. Development of the graphics model consisted of establishing an interface to the X Windows system. Later research will build upon this interface. The expected product will be a graphics editor capable of creating and editing all of the constructs contained in the IDEF sub 0 syntax. GRA

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, alogorithms, and specific applications, e.g., CAD/CAM.

N90-17322 Rutgers - The State Univ., New Brunswick, NJ.
PROJECTION TECHNIQUES FOR IMAGE RESTORATION Ph.D. Thesis
Christine Podilchuk 1988 195 p
Avail: Univ. Microfilms Order No. DA8914264

Image restoration refers to a class of problems that is encountered in every scientific discipline, from accurately determining the position of the stars to determining the finest molecular structure. A simple formulation of the image restoration problem is: given a measurement of the blurred image corrupted with noise and a model of the degradation operator, find the desired image. One source of degradation common to all imaging systems is the finite aperture size which acts like a lowpass filter. The image restoration problem can be discretely formulated as a set of linear equations. A direct inversion of the degradation operator results in a poor estimate due to noise, measurement error and the ill-conditioned nature of most practical systems. When the degradation operator is rank-deficient, inversion type techniques cannot recover the fine image details associated with the high spatial frequencies. A novel iterative restoration algorithm has been developed which is based on the concept of projection onto convex sets. The technique incorporates a priori information in the form of linear and nonlinear constraints. The general form of the algorithm allows for its use in other digital signal processing applications. These applications include channel equalization, pattern analysis for machine vision, adaptive array processing, spectral estimation and neural networks. Dissert. Abstr.

N90-17323*# Cornell Univ., Ithaca, NY. Dept. of Computer Science.
CONCURRENCY CONTROL FOR TRANSACTIONS WITH PRIORITIES
Keith Marzullo May 1989 19 p Submitted for publication
(Contract NAG2-593; N00140-87-C-8904; ARPA Order 6037)
(NASA-CR-186268; NAS 1.26:186268; TR-89-996) Avail: NTIS HC A03/MF A01 CSCL 09B

Priority inversion occurs when a process is delayed by the actions of another process with less priority. With atomic transations, the concurrency control mechanism can cause delays, and without taking priorities into account can be a source of priority inversion. In this paper, three traditional concurrency control algorithms are extended so that they are free from unbounded priority inversion. Author

N90-17324# Y-ARD Ltd., Glasgow (Scotland).
THE PERFORMANCE IMPLICATIONS OF ADA IN A MASCOT 3 DESIGN Final Report
D. N. MacLean, R. H. Murray, and J. D. Hamilton Feb. 1988 121 p
(Contracts ARE-NSW32A/1526; RSRE-A94C/2598)
(YM-5748-M304/2; BR104948; ETN-90-96147) Copyright Avail: NTIS HC A06/MF A01

In a continuing study of the use of Ada in Modulation Approach to Software Construction Operation and Test 3 (MASCOT 3) design, activities carried out to gain evidence on the practicality and performance characteristics of Ada as a language for programming critical real time applications are described. The Ada code generated for a fragment of a command and control system is extended into a runnable test system. The description of the development environment is given. The design of the test system and the underlying philosophy are described. Modules of particular interest are detailed. The problems encountered during the development process are indicated. Conclusions and recommendations are given. ESA

N90-17325# Tresp Associates, Inc., Alexandria, VA.
MPLUS DATABASE SYSTEM
20 Jan. 1989 25 p
(Contract DE-AC05-88OR-21850)
(DE90-004146; DOE/OR-21850/T1) Avail: NTIS HC A03/MF A01

The MPlus Database program was developed to keep track of mail received. This system was developed by TRESP for the Department of Energy/Oak Ridge Operations. The MPlus Database program is a PC application, written in dBase III+ and compiled with Clipper into an executable file. The files you need to run the MPLus Database program can be installed on a Bernoulli, or a hard drive. The use of this database is discussed. DOE

N90-17326# Sandia National Labs., Albuquerque, NM.
THE EPSILON-2 HYBRID DATAFLOW ARCHITECTURE
V. G. Grafe and J. E. Hoch 8 Nov. 1989 8 p Presented at the COMPCON 1990, San Francisco, CA, 27 Feb. - 1 Mar. 1990
(Contract DE-AC04-76DP-00789)
(DE90-003152; SAND-89-2622C; CONF-900251-1) Avail: NTIS HC A02/MF A01

EPSILON-2 is a general parallel computer architecture that combines the fine grain parallelism of dataflow computing with the sequential efficiency common to von Neumann computing. Instruction level synchronization, single cycle context switches, and RISC-like sequential efficiency are all supported in EPSILON-2.

The general parallel computing model of EPSILON-2 is described, followed by a description of the processing element architecture. A sample code is presented in detail, and the progress of the physical implementation discussed. DOE

N90-17327# Maryland Univ., College Park. Center for Automation Research.
VISION-BASED NAVIGATION AND PARALLEL COMPUTING Annual Report No. 1, May 1988 - May 1989
Larry S. Davis, Daniel DeMenthon, Thor Bestul, and David Harwood Aug. 1989 54 p
(Contract DACA76-88-C-0008; ARPA Order 6350)
(AD-A214481; ETL-0548) Avail: NTIS HC A04/MF A01
CSCL 12/5

This report describes research performed during the period May 1988 to May 1989 under DARPA support. The report contains discussion of four main topics: (1) On-going research on visual navigation, focusing on a system named RAMBO, for the study of robots acting on moving bodies; (2) Development and implementation of parallel algorithms for image processing and computer vision on the Connection Machine and the Butterfly; (3) Development of parallel heuristic search algorithms on the Butterfly that have linear speedup properties over a wide range of problem sizes and machine sizes; and (4) Development of Connection Machine algorithms for matrix operations that are key computational steps in many image processing and computer vision algorithms. This research has resulted in twelve technical reports, and several publications in conferences and workshops. GRA

N90-17328# Washington Univ., Seattle. Dept. of Mathematics.
PIECEWISE LINEAR-QUADRATIC PROGRAMMING AND ITS APPLICATIONS Final Report, 1 Jun. 1987 - 30 Oct. 1988
R. T. Rockafellar 1 Dec. 1988 14 p
(Grant AF-AFOSR-0281-87; AF Proj. 2304)
(AD-A214489; AFOSR-89-1354TR) Avail: NTIS HC A02/MF A01 CSCL 12/4

Piecewise linear-quadratic programming problems are a fundamental class of optimization problems in the mathematical modeling of multistage decision making and large scale dynamic systems, with or without the presence of uncertainty. Patterns of mathematical structure in such problems were identified that cover wide areas of application and are conductive to the development of solution methodology. This structure was utilized in new numerical procedures, which include finite-envelope methods and a double conjugate gradient method; as well as a simplex-like algorithm for solving small scale subproblems. Preliminary tests were made of these procedures on problems of modest size. To pave the way for experiments with larger examples, programs modules for handling discrete-time dynamics were coded in part. For decision problems involving scenarios, a progressive hedging algorithm have been devised. This provides a systematic approach to optimization in cases where uncertainty cannot be modeled in terms of standard random variables. GRA

N90-17329# Bolt, Beranek, and Newman, Inc., Cambridge, MA.
ACCESS TO MULTIPLE UNDERLYING SYSTEMS IN JANUS Interim Technical Report
Philip Resnik Sep. 1989 32 p
(Contract N00014-85-C-0016)
(AD-A214585; BBN-7142) Avail: NTIS HC A03/MF A01
CSCL 05/2

The job of the back-end of any natural language interface is to translate a logical description of what the user wants (a request) into an efficient plan for fulfilling that request. Typically the request is to produce data from some underlying system; that is, the database, applications program, or other system with which the user is communicating by means of the interface. There has been a fair amount of work on the problem of natural language interfaces to single underlying systems. As computer systems become more complex, there is more opportunity for combining the strengths of more than one system in order to perform a task. For example, one might imagine combining several resources: a database for storing relational information with an applications program to perform calculations based on that information, an expert system to perform inferences, and a display system to present data in a useful way. In such an environment a seamless natural language interface can become a very effective tool, allowing the user to retrieve and manipulate information without needing to pay attention to the details of any particular resource. The back-end of such an interface, however, is necessarily more complex: not only must it be able to translate the user's request into executable code, but it must also be capable of organizing the various resources at its disposal, choosing which combination of resources to use, and supervising the transfer of data among them. This is called the Multiple Underlying System (MUS) problem. One appoach to the MUS problem is described. GRA

N90-17330# Bolt, Beranek, and Newman, Inc., Cambridge, MA.
RESEARCH AND DEVELOPMENT IN NATURAL LANGUAGE UNDERSTANDING AS PART OF THE STRATEGIC COMPUTING PROGRAM Annual Report, 21 Dec. 1986 - 20 Dec. 1987
Ralph M. Weischedel 1989 49 p
(Contract N00014-85-C-0016; ARPA Order 5257)
(AD-A214586; BBN-6463) Avail: NTIS HC A03/MF A01
CSCL 12/9

Pioneering work is reported in knowledge representation for natural language processing. In BBN's natural language understanding and generation system (Janus), a hybrid approach was used to representation, employing an intensional logic for the representation of the semantics of utterances and a taxonomic language with formal semantics for specification of descriptive constants and axioms relating them. Remarkably, 99.9 percent of 7,000 vocabulary items in the natural language applications could be adequately axiomatized in the taxonomic language. The problems, issues, and approaches to dealing with ill-formed input are reviewed. There are several purposes: (1) to define a class of phenomena that may be termed ill-formed input; (2) to differentiate this class from problems of spoken language understanding; (3) to briefly summarize the state of the art in understanding ill-formed input; (4) to indicate areas for further theoretical progress; and (5) to speculate regarding where there may be strong practical payoff. GRA

N90-17331# Bolt, Beranek, and Newman, Inc., Cambridge, MA.
RESEARCH AND DEVELOPMENT IN NATURAL LANGUAGE UNDERSTANDING AS PART OF THE STRATEGIC COMPUTING PROGRAM Annual Technical Report, Dec. 1987 - Dec. 1988
Lance A. Ramshaw Jul. 1989 185 p
(Contract N00014-85-C-0016; ARPA Order 5257)
(AD-A214587; BBN-7047) Avail: NTIS HC A09/MF A02
CSCL 12/9

The use is explored of a model of the plans and goals of the user of a computer system to increase the robustness of the system's natural language understanding component. Many examples of ill-formedness that people routinely and easily correct can be resolved by a natural language system only if it makes use of knowledge of the pragmatic context. This investigation centers around examples of alias errors, where the ill-formedness is due to a single word that is incorrect but still lexically understood, as with the substitution of, on for in, in the phrase stay on good shape. Localizing and resolving such errors frequently depends on pragmatic knowledge. A model is presented of a model for pragmatic context within expert advising dialogues, where an agent who is building a plan to solve a problem consults with a domain expert, and develops methods for applying that model to resolving ill-formed input. This approach was implemented in a system called Pragma, which suggest corrections based on pragmatic context for alias errors in naval domain queries, using techniques that could also be extended to other classes of ill-formedness and to generating cooperative responses. Pragma demonstrated that a model capturing the pragmatic structure of a particular discourse setting can be used to increase the robustness of a natural language interface. GRA

N90-17332# Bolt, Beranek, and Newman, Inc., Cambridge, MA.
PARROT: THE JANUS PARAPHRASER
Dawn M. MacLaughlin Sep. 1989 62 p
(Contract N00014-85-C-0016)
(AD-A214588; BBN-7139) Avail: NTIS HC A04/MF A01
CSCL 05/2

Parrot, a system that generates English text from a WML (World Model Language) expression produced by BBN's Irus-II natural language understanding system, is described. The WML represents Irus-II's understanding of its input query. Parrot works with BBN's Spokesman text generation system to generate the paraphrase. Parrot and Irus-II are integrated as part of the Janus seamless interface system, which allows a user to query the underlying expert and database systems in English, as well as use menus, graphics, maps etc. to access information. A general description of Parrot is provided as are implementation details for the person who may want to maintain or extend it. GRA

N90-17333# Bolt, Beranek, and Newman, Inc., Cambridge, MA.
RESEARCH AND DEVELOPMENT IN NATURAL LANGUAGE UNDERSTANDING AS PART OF THE STRATEGIC COMPUTING PROGRAM Final Report
Damaris Ayuso, Madeleine Bates, Robert Bobrow, Marie Meteer, Lance A. Ramshaw, Varda Shaked, and Ralph M. Weischedel 1988 51 p
(Contract N00014-85-C-0016; ARPA Order 5257)
(AD-A214611; BBN-7191) Avail: NTIS HC A04/MF A01
CSCL 05/7

A collection of reprints reporting natural language research is presented. The problem of acquiring linguistic knowledge is the chief obstacle to widespread use of natural language technology. Results are reported of five to tenfold increase in the productivity in moving the Janus and Parlance natural language shells to new application domains. The ability of natural language systems to cooperatively handle novel, errorful, or incomplete forms is also critical; new techniques are reported for intelligently and graceful response to such forms. An implementation of a discourse module for understanding definite reference is also reported. GRA

N90-17334# Bolt, Beranek, and Newman, Inc., Cambridge, MA.
IRUS-II USER MANUAL Interim Technical Report
Dawn M. MacLaughlin, Kimberle Koile, and Edward Walker Sep. 1989 62 p
(Contract N00014-85-C-0016)
(AD-A214612; BBN-7143) Avail: NTIS HC A04/MF A01
CSCL 12/5

This user's manual for the Irus-II natural language system describes the capabilities of the different modes of the end user interface for Irus-II, including entering and editing queries, the history list, control of processing, viewing of the intermediate results, window management and the use of files of queries. There is a companion document to this one, A Guide to Irus-II Application Development, BBN Report 7144, intended for use by developers, that describes the internal operation of Irus-II, including the dictionary, domain model, semantic interpretation rules, and back-end translation rules. Irus-II is part of a larger system called Janus, which is composed of a number of seamless interface utilities, including understanding (provided by Irus-II), generation (provided by Spokesman), maps, and other graphics tools. GRA

N90-17335# Teledyne CAE, Toledo, OH. Turbine Engines.
INDUSTRIAL MODERNIZATION INCENTIVES PROGRAM: COMPUTER-AIDED LOG BOOK Final Report, Dec. 1986 - Apr. 1989
Devinder K. Bawa Oct. 1989 208 p
(Contract F33657-86-C-2024)
(AD-A214614; TCAE-2404) Avail: NTIS HC A10/MF A02
CSCL 12/7

The objective of the Computer Aided Log Book (CALB) project was to design, develop and demonstrate a computer based system that provided closed loop configuration control, engineering change tracking, and as built configuration reporting in real time. The system automates collection and verification of engine back-up data during the assembly process and provides component lot traceability. System benefits include reduction in direct and indirect labor costs, reduction in redundant data storage and configuration inconsistencies and improved logistics support of shipped engines. GRA

N90-17336# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
THE BIFURCATION INTERPRETER: A STEP TOWARDS THE AUTOMATIC ANALYSIS OF DYNAMICAL SYSTEMS
Harold Abelson Sep. 1989 44 p
(Contract N00014-89-J-3202)
(AD-A214618; AI-M-1174) Avail: NTIS HC A03/MF A01
CSCL 12/5

The Bifurcation Interpreter is a computer program that autonomously explores the steady state orbits of one-parameter families of periodically driven oscillators. To report its findings, the Interpreter generates schematic diagrams and English text descriptions similar to those appearing in the science and engineering research literature. Given a system of equations as input, the Interpreter uses symbolic algebra to automatically generate numerical procedures that simulate the system. The Interpreter incorporates knowledge about dynamical systems theory, which it uses to guide the simulations, to interpret the results, and to minimize the effects of numerical error. GRA

N90-17337# Stanford Univ., CA. Dept. of Computer Science.
NETWORK FLOW ALGORITHMS
Andrew V. Goldberg, Eva Tardos, and Robert E. Tarjan (Princeton Univ., NJ.) Apr. 1989 80 p
(Contract N00014-87-K-0467)
(AD-A214689; CS-TR-216-89) Avail: NTIS HC A05/MF A01
CSCL 12/4

Network flow problems are central problems in operations research, computer science, and engineering and they arise in many real world applications. Starting with early work in linear programming and spurred by the classic book of Ford and Fulkerson, the study of such problems has led to continuing improvements in the efficiency of network flow algorithms. In spite of the long history of this study, many substantial results have been obtained within the last several years. This survey examines some of these recent developments and the ideas behind them. The classical network flow problems are discussed along with the maximum flow problem, the minimum-cost circulation problem, and a less standard problem, the generalized flow problem, sometimes called the problem of flows with losses and gains. The terminology needed to discuss network flow problems is studied. The maximum flow problem is also discussed, as are different aspects of the minimum-cost circulation problem. The generalized flow problem is also discussed. Some of the history of network flow research is reviewed, comments are made on some of the results presented along with some results not covered in this survey. Algorithms whose running time is small as a function of the size of the network and the numbers involved (e.g., capacities, costs, or gains) are of interest. GRA

N90-17338# California Univ., Los Angeles. Dept. of Computer Science.
EDISON PROJECT Final Report
Michael G. Dyer, Margot Flowers, and Jack Hodges 1989 49 p Presented at the 11th Annual Conference of the Cognitive Science Society, Ann Arbor, MI, 16-19 Aug. 1989
(Contract N00014-86-K-0615)
(AD-A214724) Avail: NTIS HC A03/MF A01 CSCL 12/9

The EDISON project is one of developing computational models of creative reasoning and problem-solving with respect to mechanical devices. The overall approach has been that of representing devices as symbolic structures (i.e., a naive mechanics approach). The focus of our research has been on representational and processing constructs to support the following cognitive tasks: (1) comprehension of natural language text describing mechanical devices, (2) simulation of device behavior through manipulating symbolic representations of device motions, (3) improvisation

through adapting one device for use in an alternate domain, and (4) device invention through mutation of device features. These four tasks serve to test the viability of EDISON device representations. In carrying out this research, the project leaders were influenced both by the computational and psychological literature. There are four areas of computational modeling from which the EDISON project has drawn inspiration: (1) Qualitative physics, (2) Natural Language Processing (NLP) for comprehension and invention, (3) Memory Organization for Case-Based Recall, (4) and Automated Discovery. GRA

N90-17339# Vanderbilt Univ., Nashville, TN. Dept. of Mathematics.
MATCHING EXTENSION IN REGULAR GRAPHS
M. D. Plummer 1989 17 p
(Contract N00014-85-K-0488)
(AD-A214757) Avail: NTIS HC A02/MF A01 CSCL 12/2

This paper deals with extending matching in regular graphs. There are two main results. The first presents a sufficient condition in terms of cyclic connectivity for extending matching in regular bipartite graphs. This theorem generalizes an earlier result due to Holton and the author. The second result deals with regular-but not necessarily bipartite-graphs. In this case, it is known that a result analogous to that obtained in the bipartite case is impossible, but a new proof is given of a result of Naddef and Pulleyblank which guarantees that a regular graph with an even number of points which has sufficiently large cyclic connectivity will be bicritical. GRA

N90-17340# BBN Systems and Technologies Corp., Cambridge, MA.
A GUIDE TO IRUS-2 APPLICATION DEVELOPMENT Interim Report
Ralph M. Weischedel, Damaris Ayuso, Gerard Donlon, Dawn M. MacLaughlin, Lance A. Ramshaw, Philip Resnik, and Varda Shaked Sep. 1989 82 p Sponsored in part by DARPA, Arlington, VA
(Contract F00014-85-C-0016)
(AD-A214758; BBN-7144) Avail: NTIS HC A05/MF A01 CSCL 12/5

IRUS-2 is the understanding subsystem of the Janus natural language interface. IRUS-2 is a natural language understanding (NLU) shell. That is, it contains domain-independent algorithms, a large grammar of English, domain-independent semantic interpretation rules, and a domain-independent discourse component. In addition, several software aids are provided to customize the system to particular application domains. These software aids output the four knowledge bases necessary for IRUS-2 to correctly interpret English utterances and generate appropriate code for simultaneous access to multiple application systems. GRA

N90-17341# Alphatech, Inc., Burlington, MA.
DEVELOPMENT OF ADVANCED WTA ALGORITHMS FOR PARALLEL PROCESSING Final Report
David A. Castanon Oct. 1989 89 p
(Contract N00014-88-C-0718)
(AD-A214874; TR-457) Avail: NTIS HC A05/MF A01 CSCL 15/3

The objective of weapon-target assignment (WTA) in a ballistic missile defense (BMD) system is to determine how defensive weapons should be assigned to boosters and reentry vehicles in order to maximize the survival of assets belonging to the U.S. and allied countries. The implied optimization problem requires consideration of a large number of potential weapon target assignments in order to select the most effective combination of assignments. The resulting WTA optimization problems are among the most complex encountered in mathematical programming. Indeed, simple versions of the WTA problem have been shown to be NP-complete, implying that the computations required achieve optimal solutions grow exponentially with the numbers of weapons and targets considered in the solution. The computational complexity of the WTA problem has motivated the development of heuristic algorithms that are not altogether satisfactory for use in Strategic Defense Systems (SDS). Some special cases of the WTA problem are not NP-complete and can be solved using standard optimization algorithms such as linear programming and maximum marginal return algorithms; these algorithms enjoy low computational requirements and therefore were adopted as heuristics for solving more general WTA problems. However, experimental studies have demonstrated that these heuristic algorithms lead to significantly suboptimal solutions for certain scenarios. GRA

N90-17342# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
A THEORY FOR GRAPH-BASED LANGUAGE SPECIFICATION, ANALYSIS, AND MAPPING WITH APPLICATION TO THE DEVELOPMENT OF PARALLEL SOFTWARE Ph.D. Thesis
Paul D. Bailor Sep. 1989 516 p
(AD-A214910; AFIT/DS/ENG/89-1) Avail: NTIS HC A22/MF A03 CSCL 12/5

A generalized formal language theory model and associated theorems is developed for the specification, analysis, and mapping of graphs and graph-based languages. The developed model, defined as a graph generative system, is analyzed from a set theoretic, formal language, algebraic, and abstract automata perspective. As a result of the analysis, numerous theorems pertaining to the properties of the model, graphs, and graph-based languages are derived. The graph generative system model also serves as the basis for applying graph based languages to areas such as the specification and design of software and visual programming. The specific application area emphasized is the use of graph-based languages as user-friendly interfaces for wide-spectrum languages that include structures for representing parallelism. The goal of this approach is to provide an effective, efficient, and formal method for the specification, design, and rapid prototyping of parallel software. To demonstrate the theory's utility and the feasibility of the application, two models of parallel computation are chosen. The widely used Petri net model of parallel computation is formalized as a graph-based language. The Petri net syntax is formally mapped into the corresponding syntax of a Communicating Sequential Processes (CSP) model of parallel computation where CSP is used as the formalism for extended wide-spectrum languages. Finally, the Petri net to CSP mapping is analyzed to demonstrate that the CSP specification formally behaves in a manner equivalent to the Petri net model. GRA

N90-17343# Naval Postgraduate School, Monterey, CA.
THE MOVING PLATFORM SIMULATOR 2: A NETWORKED REAL-TIME VISUAL SIMULATOR WITH DISTRIBUTED PROCESSING AND LINE-OF-SIGHT DISPLAYS M.S. Thesis
Randolph P. Strong and Michael C. Winn Jun. 1989 159 p
(AD-A214936) Avail: NTIS HC A08/MF A01 CSCL 05/6

Previous research has produced a real time Moving Platform Simulator using Defense Mapping Agency digital terrain elevation data and an Iris 4D/70GT graphics workstation. That effort is continued with the multiple goals of investigating the effects on simulator performance of using higher resolution terrain and different terrain drawing algorithms. Also investigated was the integration of real time, actual platform intervisibility determinations into the simulator. Included in this effort was a study of modeling time and a real world coordinate system. Additional work was performed on using a distributed computed architecture to maximize performance. GRA

N90-17344# Naval Postgraduate School, Monterey, CA.
A KNOWLEDGE BASED APPROACH TO PROGRAM DEBUGGING Final Report, Oct. 1987 - Sep. 1989
Yuh-jeng Lee 13 Sep. 1989 78 p
(AD-A214941; NPS52-89-060) Avail: NTIS HC A05/MF A01 CSCL 12/5

The use of executable specifications in automating the process of debugging logic programs is explored. A computer model was formulated that encodes programming knowledge including a classification of program bugs, heuristics that analyze and repair

program errors, and operational semantics off the language, and is capable of reasoning with programs and their specifications. The realization of the methodology is the Constructive Interpreter which functions as a debugger as well as program synthesizer. It contains three major components: test case generator, bug locator, and bug corrector. The test case generator can generate test data systematically by executing specifications. The bug locator will automatically locate a bug should the program fail to compute an answer that agrees with the specifications. The bug corrector will analyze the nature of the bug and invoke correction heuristics which might involve the use of a deductive theorem prover which will try to construct a proof and deduce sufficient conditions to amend the program, and an inductive program generator which will synthesize the missing part of the program. The approach and an implementation of the experimental prototype debugger is presented. GRA

N90-17345# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
COMPUTER PERCEPTION OF THREE-DIMENSIONAL OBJECTS Memorandum Report
Thomas Marill Aug. 1989 41 p
(Contract N00014-85-K-0124)
(AD-A215058; AI-M-1136) Avail: NTIS HC A03/MF A01 CSCL 12/9

The following problem is posed: To develop a program which takes line drawings as input and constructs 3-D objects as output; such that output objects are the same as the ones seen when the input line drawing is seen. The principle is introduced of minimum standard deviation of angles (MSDA) and a program based on MSDA is discussed. The results are presented of testing this program with a variety of line drawings and show that the problem constitutes a solution to the stated problem over the range of line drawings tested. Finally, this work is related to its historical antecedents in the psychological and computer vision literature. GRA

N90-17346# Naval Postgraduate School, Monterey, CA. Dept. of Mathematics.
A NOTE ON SMALE'S GLOBAL NEWTON METHOD Report, May - Aug. 1989
Allen A. Goldstein 18 Aug. 1989 8 p
(Grants NPS-LMC-M4E1; NIH-RR-01243-05)
(AD-A215139; NPS53-89-016) Avail: NTIS HC A02/MF A01 CSCL 12/2

An implementation is presented for Smale's Global Newton method in a simple setting. The iteration count for the algorithm is sensitive only to the quantity beta sub 0. GRA

N90-17347# North Carolina Univ., Chapel Hill. Dept. of Computer Science.
TWO ADAPTIVE TECHNIQUES LET PROGRESSIVE REFINEMENT OUTPERFORM THE TRADITIONAL RADIOSITY ALGORITHM
John M. Airey and Ouh-Young Ming Jan. 1989 12 p
(Contract N00014-86-K-0680)
(AD-A215174; TR-89-020) Avail: NTIS HC A02/MF A01 CSCL 20/3

Two adaptive techniques applied to form factor calculation in the progressive refinement version of radiosity allow it to compute the final converged result quicker than the traditional, matrix-solution-based, radiosity algorithm. Adaptive components of the algorithm are: (1) adaptive subdivision of the hemi-cube/sphere as a function of delta form factor distribution; (2) adaptive reduction as a proportion of unshot radiosity in progressive refinement iterations; and (3) switching from a hemi-cube Z-buffer to ray sampling at the appropriate point in the computation to optimize efficiency. The key idea is that of importance sampling. The reasoning is similar to that used to eliminate unnecessary samples in traditional ray tracing and obtain the path tracing algorithm. The subdivision pattern and resolution of the hemi-cube are determined adaptively to keep the energy carried by each hemi-cube sample constant. This also reduces the error variance of the hemi-cube samples. Experimental evidence suggests that the progressive refinement approach must calculate the number of form factor as the traditional method before the process has converged. If it is assumed that form factor calculations consume over 90 percent of the computation, this means the progressive refinement approach takes 2x as long to calculate the fully converged solution. Use of the above adaptive techniques can yield a 7-fold speedup of the progressive refinement approach, with the same error restrictions on the image, on data sets ranging from a couple of hundred to thousands of patches. GRA

N90-17348# Rome Air Development Center, Griffiss AFB, NY.
RADC FAULT TOLERANT SYSTEM RELIABILITY EVALUATION FACILITY In-House Report, Aug. 1988 - Feb. 1989
Joseph Caroli, Frank Fieldson, Jack Hewitt, and Matt Piano Oct. 1989 97 p
(AD-A215298; RADC-TR-89-165) Avail: NTIS HC A05/MF A01 CSCL 12/5

The Systems Reliability and Engineering Division of the Rome Air Development Center (RADC/RBE) is in the process of developing a Fault Tolerant System Reliability Evaluation Facility. The facility has the analysis/evaluation capability necessary to perform reliability modeling for virtually any fault tolerant system. RADC/RBE offers modeling expertise as a support service to DOD agencies with fault tolerant system reliability modeling needs. The facility relies heavily on the use of computer-aided reliability modeling tools. Since no single tool is perfect for every application, RADC/RBE has acquired several. They are CARE III, FASTER, HARP, MIREM, REST, and R and MA2T2. This functional capabilities plan analyzes the capabilities, strengths and weaknesses of each of the above tools. The overall capabilities of the facility are also discussed and sample modeling cases are provided. A survey of tools was also undertaken as part of this study. Short abstracts are provided for 27 modeling tools both new and old. GRA

N90-17349# Mission Research Corp., Santa Barbara, CA.
AN APPROACH TO THE DEVELOPMENT OF SOFTWARE FOR COMPUTER-AIDED DESIGN OF SATELLITE COMMUNICATIONS RECEIVERS FOR OPERATION IN SCINTILLATING CHANNELS Technical Report, 14 Sep. 1988 - 28 Apr. 1989
Robert L. Bogusch 28 Apr. 1989 51 p
(Contract DNA001-88-C-0194)
(AD-A215299; MRC-R-1231; DNA-TR-89-109) Avail: NTIS HC A04/MF A01 CSCL 20/14

An extensive inventory of techniques to provide robust communications to nuclear-disturbed signal propagation channels was developed and tested over the past decade. The work described is intended to facilitate the process of placing these mitigation techniques in the hands of the designer through the development of a computer-aided design (CAD) software package. To maximize its utility, the CAD software is being developed to run on desktop personal computers (PCs). When developed, this software will allow signal statistical parameters obtained from Defense Nuclear Agency signal specification and from Nuclear Criteria Group signal criteria to be readily incorporated in the communications link design process. The PC-based CAD software will enable the designer to input communications system characteristics that may be constrained by other considerations, together with DNA specifications of disturbed signal parameters that the system must be designed to withstand. The CAD software will then provide information on modulation, demodulation, tracking, coding, and diversity requirements to obtain specific levels of performance over specified ranges of nuclear disturbances. when fully developed, the CAD software should significantly simplify the design of robust digital communications systems that must operate in fading radio channels. GRA

N90-17350# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
THE GRAPHICAL REPRESENTATION OF ALGORITHMIC PROCESSES, VOLUME 1 M.S. Thesis
Keith C. Fife Dec. 1989 218 p
(AD-A215359; AD-F000150; AFIT/GCE/ENG/89D-2-Vol-1)
Avail: NTIS HC A10/MF A02 CSCL 12/5

Traditionally, software engineers have described algorithms and data structures using graphical representations such as flow charts, structure charts, and block diagrams. These representations can give a static general overview of an algorithm, but they fail to fully illustrate an algorithm's dynamic behavior. Researchers have begun to develop systems to visualize, or animate, algorithms in execution. The form of the visualization depends on the algorithm being examined, the data structures being used, and the ingenuity of the programmer implementing the animation. The development of the AFIT Algorithm Animation Research Facility is presented. The goal of the study is to develop a method for developing algorithm animations and to develop an environment in which the animations can be displayed. The application of modern software engineering techniques is emphasized. The development follows a classic life-cycle software engineering paradigm: requirements, design, implementation, and testing. An object-oriented approach is used for the preliminary design. The system is implemented with the C programming language on a Sun workstation and uses the Sun View window-based environment. A framework is proposed for developing algorithm animations that minimizes the development time for client-programmers. GRA

N90-17351# Naval Ocean Systems Center, San Diego, CA.
FRACTAL-BASED IMAGE COMPRESSION Interim Report
R. D. Boss and E. W. Jacobs Sep. 1989 33 p Sponsored by Chief of Naval Research, Arlington, VA
(AD-A215400; NOSC/TR-1315) Avail: NTIS HC A03/MF A01 CSCL 12/1

A short review of the theory of iterated function systems (IFS), a thorough explanation of their implementation, and an example using computer code useful in developing encoded images are presented. An example of an encoded map, with a brief discussion of data compression and error analysis, is presented. Details of an extension of IFS codes which allows for mixing of images, thereby resulting in a system with substantially increased power, are given. A simple scheme for automatic generation of IFS codes is given, followed by a discussion of improvements which may lead to a more generally useful data compression system. GRA

N90-17352# Massachusetts Inst. of Tech., Cambridge. Microsystems Technology Labs.
COMPUTER-AIDED FABRICATION OF INTEGRATED CIRCUITS Semiannual Technical Report, 1 Apr. - 30 Sep. 1989
Paul Penfield, Jr., Dimitri A. Antoniadis, Stanley B. Gershwin, Stephen D. Senturia, Emanuel M. Sachs, and Donald E. Troxel 30 Sep. 1989 32 p
(Contracts MDA972-88-K-0008; N00014-85-K-0213)
(AD-A215439) Avail: NTIS HC A03/MF A01 CSCL 12/5

The major objective of this research program is to develop a Computer Aided Fabrication (CAF) environment to support the design, implementation, and manufacturing of processes for integrated circuits with special emphasis on prototyping and application specificity. The primary testbed for all components of the CAF system is the Integrated Circuits Lab at MIT. GRA

N90-17353# Grumman Aerospace Corp., Bethpage, NY.
COMPUTER-AIDED DESIGN FOR BUILT-IN-TEST (CADBIT). VOLUME 1: TECHNICAL ISSUES Final Report, Sep. 1986 - Sep. 1988
Theo J. Monahos Oct. 1989 164 p
(Contract F30602-86-C-0219)
(AD-A215737; RADC-TR-89-209-Vol-1) Avail: NTIS HC A08/MF A01 CSCL 12/5

CAD-BIT is a development program to specify the implementation of an automated procedure to integrate Built-In-Test into the design of Printed Circuit Boards (PCBs) on Computer Aided Design workstations. When fully developed, the CAD-BIT software will be capable of operating on generic workstations meeting various standards. These standards include those for operating system (UNIX), programming language (C), and graphical data interchange Initial Graphics Exchange Specification. The program's purpose was to develop the design of the automated procedure, the associated BIT data base, and a software specification for the CAD-BIT module ready for encoding. CAD workstations and BIT techniques and their applications were also surveyed to determine standards required for the CAD-BIT module implementation and to establish requirements for and define the structure of the BIT data base. Volume 1 is a general CAD-BIT description and provides useful information for any type of involvement with CAD-BIT. It includes a detailed description of the automated procedure. The description contains text, flow diagram of the procedure operations and its data, sets of menu sequences showing menu options, selections, and resulting operations. Algorithms and formulas are included. The CAD-BIT Data Base and its files are described. GRA

N90-17354# Grumman Aerospace Corp., Bethpage, NY.
COMPUTER-AIDED DESIGN FOR BUILT-IN-TEST (CADBIT). VOLUME 2: BIT LIBRARY Final Report, Sep. 1986 - Sep. 1988
Hank Baluta Oct. 1989 315 p
(Contract F30602-86-C-0219)
(AD-A215738; RADC-TR-89-209-Vol-2) Avail: NTIS HC A14/MF A02 CSCL 12/5

CAD-BIT is a development program to specify the implementation of an automated procedure to integrate Built-In-Test (BIT) into the design of printed circuit boards on computer aided design workstations. When fully developed, the CAD-BIT software will be capable of operating on generic workstations meeting various standards. These standards include those for operating system (UNIX), programming language (C), and graphical data interchange Initial Graphics Exchange Specification (IGES). This volume contains a description of the BIT data base library elements and BIT library elements for the following BIT techniques: On-board ROM; Microprocessor BIT; Microdiagnostics; On-board integration of VLSI Chips BIT (OBIVCB); Built-in logic block observer (BILBO); Error detection and correction codes; Scan; Digital wraparound; Pseudo random pattern generator with multiple input shift register (PRPG/MISR); Comparator; Voltage summing; Redundancy; and Analog wraparound. The data is used to encode CAD-BIT's BIT technique data base during the implementation phase. In addition, it illustrates the required data for adding new BIT techniques. It also provides useful data to the future circuit designer/CAD-BIT user on the BIT techniques, their implementation, and the default circuit components. GRA

N90-17355# Grumman Aerospace Corp., Bethpage, NY.
COMPUTER-AIDED DESIGN FOR BUILT-IN-TEST (CADBIT). VOLUME 3: SOFTWARE SPECIFICATION Final Report, Sep. 1986 - Sep. 1988
Tracy Kelly Oct. 1989 146 p
(Contract F30602-86-C-0219)
(AD-A215739; RADC-TR-89-209-Vol-3) Avail: NTIS HC A07/MF A01 CSCL 12/5

CAD-BIT is a development program to specify the implementation of an automated procedure to integrate Built-In-Test (BIT) into the design of printed circuit boards on computer aided design workstations. When fully developed, the CAD-BIT software will be capable of operating on generic workstations which meet various standards. The standards include those for operating system (UNIX), programming language (C), and graphical data interchange Initial Graphic Exchange Specification (IGES). The purpose of this program was to develop the design of the automated procedure, the associated BIT data base, and a software specification for the CAD-BIT module ready for encoding. CAD workstations and BIT techniques and their applications were also surveyed to determine standards required for the CAD-BIT module implementation and to establish requirements for and define the structure of the BIT data base. This volume contains the CAD-BIT

software requirements specification which establishes the requirements for the computer software configuration item identified as (CAD-BIT) system. It is used during the implementation as the basis for encoding the CAD-BIT software modules and the creation of its data base. GRA

N90-17356# Oak Ridge Gaseous Diffusion Plant, TN. Computing and Telecommunications Div.
INTERIM DESIGN DATABASE (IDDB) CADAM DRAWING RETRIEVAL PROGRAM USER'S MANUAL FOR THE IBM 3081
C. W. Gudmundson and R. L. Schwartz, ed. Dec. 1989 39 p Revised
(Contract DE-AC05-84OR-21400)
(DE90-004491; K/CSD/TM-75-Rev-1) Avail: NTIS HC A03/MF A01

This revised manual is a guide to the Interim Design Data Base (IDDB) CADAM drawing information retrieval program on the Martin Marietta Energy Systems, Inc., IBM 3081 unclassified computer. This revision includes several enhancements to the IDDB: the capability to view CADAM released drawings and the establishment of a Main Menu that provides access to Engineering Design Information System (EDIS) subsystems and tutorials, which includes the IDDB. An overview of the program is presented; this includes a description of the help and error messages available to the user. This manual describes how to access the IDDB and how to operate the program functions using Database 2 (DB2), Time Sharing Option (TSO), and interactive System Productivity Facility (ISPF) features employed by this program. Also described is how to access and operate the viewing facility that allows the display of CADAM drawings on low-cost terminals that have graphical support. There is also present additional information on data element descriptions, tutorial screens, and key assignment tables for specific terminals, respectively. DOE

N90-17357# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
EVALUATION OF THE MODAL TESTING MODENT SOFTWARE WITH SIMULATED DATA
Mario Kataoka Filho and Y. Soucy Aug. 1989 52 p
(INPE-4885-NTE/291) Avail: NTIS HC A04/MF A01

The results of an evaluation program of the software package MODENT, which is part of the DSM/DFL modal testing facility, are presented. In order to improve the performance of its single-degree-of-freedom (SDOF) curve fitting algorithms, MODENT contains an option called SIM which calculates and eliminates the effects of previously calculated modes. The SDOF algorithms of the package are exercised with simulated data (frequency response functions) which usually contain closely-spaced modes. The data are generated either with or without noise. The exercise shows that, used with SIM, the SDOF algorithms can produce good parameter estimation, even for noisy and/or closely-spaced modes. Therefore, MODENT can be a very good complementry tool for cross-checking the estimates calculated with the LMS software which contains completely different curve fitting algorithms.
Author

N90-16844# European Space Agency. European Space Operations Center, Darmstadt (Germany, F.R.).
EFFICIENT CALCULATION OF ARIANE ASCENT TRAJECTORIES WITH RECURSIVE QUADRATIC PROGRAMMING
W. Flury and M. Hechler *In its* Progress in Space Transportation Aug. 1989 p 509-517 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

N90-17358*# Cornell Univ., Ithaca, NY. Dept. of Computer Science.
THE USE OF EFFICIENT BROADCAST PROTOCOLS IN ASYNCHRONOUS DISTRIBUTED SYSTEMS Ph.D. Thesis
Frank Bernhard Schmuck Aug. 1988 136 p
(Grant NAG2-593)
(NASA-CR-186272; NAS 1.26:186272; TR-88-928) Avail: NTIS HC A07/MF A01 CSCL 09B

Reliable broadcast protocols are important tools in distributed and fault-tolerant programming. They are useful for sharing information and for maintaining replicated data in a distributed system. However, a wide range of such protocols has been proposed. These protocols differ in their fault tolerance and delivery ordering characteristics. There is a tradeoff between the cost of a broadcast protocol and how much ordering it provides. It is, therefore, desirable to employ protocols that support only a low degree of ordering whenever possible. This dissertation presents techniques for deciding how strongly ordered a protocol is necessary to solve a given application problem. It is shown that there are two distinct classes of application problems: problems that can be solved with efficient, asynchronous protocols, and problems that require global ordering. The concept of a linearization function that maps partially ordered sets of events to totally ordered histories is introduced. How to construct an asynchronous implementation that solves a given problem if a linearization function for it can be found is shown. It is proved that in general the question of whether a problem has an asynchronous solution is undecidable. Hence there exists no general algorithm that would automatically construct a suitable linearization function for a given problem. Therefore, an important subclass of problems that have certain commutativity properties are considered. Techniques for constructing asynchronous implementations for this class are presented. These techniques are useful for constructing efficient asynchronous implementations for a broad range of practical problems.
Author

N90-17359# Naval Postgraduate School, Monterey, CA.
A SPECIFICATION AND ANALYSIS OF THE IEEE (INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS) TOKEN RING PROTOCOL M.S. Thesis
Carl A. Raiche Jun. 1989 63 p
(AD-A214567) Avail: NTIS HC A04/MF A01 CSCL 12/7

Computer communications are becoming increasingly important in the command, control and communications community. Using models to verify that the communication protocols used by these computers function properly is a time and effort saving device. A model called systems of communicating machines combines two types of models, finite state machines and programming language models. In this thesis systems of communicating machines are used to specify and analyze the IEEE token ring protocol. The specification makes several simplifying assumptions about the protocol in order to make the analysis manageable. These simplifications include limiting the network to two machines and shortening the frame and token formats to reduce the number of transmissions on the network. This thesis exercises the resulting specification to both verify that the protocol won't fail and that the specification is correct. The type of analysis used in this thesis is called a reachability analysis or a system state analysis. This specification and analysis of the IEEE token ring protocol proves the protocol won't fail for a two machine network. This thesis also proves that the specification of the protocol is correct.
GRA

N90-17360# Colorado State Univ., Fort Collins.
PARALLEL FUNCTIONAL COMPUTATION Final Report, 15 Jun. 1986 - 14 Aug. 1989
Rodney R. Oldehoeft 9 Nov. 1989 13 p
(Contract DAAL03-86-K-0101)

(AD-A214627; ARO-23221.18-EL) Avail: NTIS HC A03/MF A01 CSCL 12/5

The magnitude of problems that people need to solve using automatic computation often exceeds the processing power of available sequential computers. However, most algorithms contain components that can execute concurrently instead of serially, and vendors have provided a variety of machines capable of parallel processing. But expected reductions in execution times did not always occur owing to ineffective utilization of available parallel hardware or excessive interprocessor communication. Programmers could sometimes manually optimize program structures to solve these problems, but this work is extraordinarily difficult, and not practical for large programs. Research into automatic parallelization follows two paths. First, because of the large investment in extant software, attempts continue toward compilers for conventional languages that map ordinary programs onto parallel architectures efficiently. Systems of this kind work best when programmers use certain easily recognizable forms in source programs and understand underlying parallel hardware. Second, research continues in this and other projects to design, implement, and evaluate new languages for which automatic parallel execution is more easily attainable. GRA

N90-17361# Maryland Univ., College Park. Dept. of Computer Science.

PARALLEL LOGIC PROGRAMMING AND PARALLEL SYSTEMS SOFTWARE AND HARDWARE Final Progress Report, 1 Apr. 1988 - 31 Mar. 1989

Jack Minker 29 Jul. 1989 17 p

(Grant AF-AFOSR-0152-88; AF Proj. 2304)

(AD-A214635; AFOSR-89-1309TR) Avail: NTIS HC A03/MF A01 CSCL 12/5

This progress report summarizes work performed under AFOSR-88-0152 on parallel logic programming, problem solving, and deductive databases. A parallel problem solving system, PRISM (Parallel Inference System), that was implemented on McMOB was ported to the BBN Butterfly machine. Two versions of PRISM were developed and are operational on the Butterfly: a message passing ring structure system and a shared-memory system. Experimental testing of PRISM on McMOB continued, while experiments were also conducted on the Butterfly systems. Three enhancements were made and completed during the grant period. These are: a capability to handle negated queries and a capability to assert and retract statements. In addition to the above, work continued in the area of informative answers to queries in deductive data bases. A thesis was completed on the subject. An interpreter was developed and is running, that can take restricted natural language as input and can respond with a cooperative natural language output. In the area of parallel software development, the following were accomplished. Theoretical work on slicing/splicing was completed. Tools were provided for software development using artificial intelligence techniques. AI software for massively parallel architectures was started. GRA

N90-17362# Carnegie-Mellon Univ., Pittsburgh, PA. Communications Design Center.

HELP DESIGN SOFTWARE PROJECT Interim Report, 4 Apr. 1987 - 30 Nov. 1988

Thomas M. Duffy, James Palmer, Brad Mehlenbacher, Guojun Zhang, and Ann Aaron 30 Nov. 1988 241 p

(AD-A214883) Avail: NTIS HC A11/MF A02 CSCL 12/5

Interactive computer systems were once used only by highly trained specialists. Today, complex computer systems are used by people with varying levels of skill and experience. Adequate on-line help systems must be designed so new or infrequency users will be able to effectively use the systems without lengthy training or experimentation. A systematic investigation was performed of on-line help and guidelines were developed for the design of on-line help systems for interactive computer systems. Three topics were hypothesized and investigated. The help database should be arranged so that it can be efficiently maintained without sacrificing the capacity for many kinds of access and it should appear consistently so that entries can be added or amended easily. Alternate organizational strategies that balanced user-friendliness with ease of maintenance were developed and tested. Each entry in the database should be structured for effective scanning and interpretation. Alternate presentation formats for on-line help information were evaluated. Optimal display strategies are reported. The type of information in the database should be specific to the users for which the on-line help system is designed. Procedures for assessing the kinds of information that will be useful were developed. Access channels to the on-line help database were designed. GRA

N90-17363# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

COMPILING SCIENTIFIC CODE USING PARTIAL EVALUATION Memorandum Report

Andrew Berlin and Daniel Weise (Stanford Univ., CA.) Jul. 1989 22 p

(Contracts N00014-86-K-0180; N00014-87-K-0828)

(AD-A215087; AI-M-1145) Avail: NTIS HC A02/MF A01 CSCL 12/5

Scientists are faced with a dilemma: Either they can write abstract programs that express their understanding of a problem, but which do not execute efficiently; or they can write programs that computers can execute efficiently, but which are difficult to write and difficult to understand. We have developed a compiler that uses partial evaluation and scheduling techniques to provide a solution to this dilemma. Where conventional compilers compile a program without any knowledge of the data the program will be run on, our system uses information about the data when transforming the program. This technique, by eliminating nearly all the user's control and data abstractions, produces high performance codes. For an important class of numerical programs, partial evaluation dramatically improves performance: we have achieved speedups over conventionally compiled code that range from seven times faster to ninety one times faster. We also show how partial evaluation can be applied to the programming of parallel computers. By eliminating inherently sequential data structure references and their associated conditional branches, partial evaluation exposes the low-level parallelism inherent in a computation. We present the results of applying a parallel scheduler to a partially evaluated program that simulates the motions of nine bodies under mutual gravitational attraction. GRA

N90-17364# Wisconsin Univ., Madison. Center for Mathematical Sciences.

LARGE-SCALE OPTIMIZATION VIA DISTRIBUTED SYSTEMS Final Technical Report, 1 Jul. 1986 - 30 Jun. 1989

Robert R. Meyer 1 Nov. 1989 9 p

(Grant AF-AFOSR-0194-86; AF Proj. 2304)

(AD-A215136; AFOSR-89-1585TR) Avail: NTIS HC A02/MF A01 CSCL 12/7

Most large scale network optimization problems exhibit structures that allow the possibility of attack via algorithms what exhibit a high degree of parallelism. Such structure include quasi-independent blocks of constraints for different commodities or time periods, and geographically disjoint components in approximating solutions. The emphases of the research were the development of new parallel optimization techniques that utilize these and related features in order to take advantage of distributed computing environments. A comparison was made of the relative efficiencies of approaches based on different computer architectures such as message passing multicomputers and shared memory multiprocessors. The parallel algorithms implemented have made possible the solution of extremely large linear networks (with more than 1 million variables) and nonlinear network optimization problems with as many as 400,000 variables or relatively modest parallel computing systems, and have displayed excellent speedups relative to the corresponding single-processor programs. GRA

N90-17365# Massachusetts Inst. of Tech., Cambridge.

CRITICAL PROBLEMS IN VERY LARGE SCALE COMPUTER SYSTEMS Semiannual Technical Report, 1 Apr. - 30 Sep. 1989

Anant Agarwal, William J. Dally, Srinivas Devadas, Thomas F.

Knight, Jr., F. Thompson Leighton, Charles E. Leiserson, Paul Penfield, Jr., Jacob K. White, and John L. Wyatt, Jr. 30 Sep. 1989 59 p
(Contract N00014-87-K-0825)
(AD-A215190) Avail: NTIS HC A04/MF A01 CSCL 12/7

The research vehicle for this contract is the largest possible computer that could be conceived for the mid to late 1990's. The technical challenges of such a machine serve as our guiding stimulus for the research carried out and reported here. We imagine this machine to occupy a 14-story building, to cost upward of $1 billion, and to be so colossal that the nation could only afford one or two of them. The available chip technology and machine size are consistent with 10 to the 15th power FLOPS and 10 to the 15th power bytes of memory. The machine will be used to solve large-scale scientific problems having both military and civilian applications. This investigation addresses the hardware technology, software techniques, algorithms, communications, processing elements, and applications. The study will determine the plausibility (not feasibility) of the machine. Progress in these various areas are highlighted in the forthcoming sections. GRA

N90-17366*# Sandia National Labs., Albuquerque, NM.
MERLIN: A SUPERGLUE FOR MULTICOMPUTER SYSTEMS
Creve Maples and Larry Witte (State Univ. of New York, Stony Brook.) 1990 17 p Presented at the COMPCON '90, San Francisco, CA, 27 Feb. - 1 Mar. 1990
(Contracts NAG1-249; DE-AC04-76DP-00789; N00014-88-K-0383; NSF DCS-83-19966; NSF CCR-87-13865; NSF CCR-87-05079)
(NASA-CR-186330; NAS 1.26:186330; DE90-005326; SAND-90-0030C; CONF-900251-2) Avail: NTIS HC A03/MF A01 CSCL 09B

Merlin is a memory based, interconnection system designed to provide very high-performance capability in a disturbed multi-computer environment. By using dynamically mapped reflective memory operations, the system creates a virtual memory environment which permits users to utilize both local and shared memory techniques. This mapped virtual memory approach permits selected information to be shared at high speeds and with relatively low latency. There is no software involvement in the actual sharing of information and the system automatically overlaps computation and communication, to the extent possible, on a word-by-word basis. Memory-to-Memory mapping allows Merlin to provide a uniform programming environment which is independent of interconnection topology, processing elements, and languages. DOE

63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

N90-17367# Institute for the Study of Intelligent Systems, Ann Arbor, MI.
A GENETIC ADAPTIVE SYSTEM FOR IMAGE UNDERSTANDING AND LEARNING RESEARCH Final Technical Report, 1 Feb. - 1 Aug. 1989
Dean Z. Douthat and Kevin W. Ross Aug. 1989 28 p
(Contract F49620-89-C-0039)
(AD-A214810; ISIS-10037U/89-02C) Avail: NTIS HC A03/MF A01 CSCL 23/3

The efforts and results of initial phase research on machine learning directed at application for real time machine vision and automatic target recognition are documented. The particular paradigm pursued is based on genetic algorithms and classifiers modeled on the summation of Mendelian genetic recombination, Darwinian selection, and ecological notions of competition. This machine learning approach is strongly supported by sound statistical theory. A second thread of research was the development of massively parallel computing hardware based on the Geometric/Arithmetic Parallel Processor (GAPP). This machine has a large number of processors, each one bit wide with a full Arithmetic/Logic Unit (full adder) and with local memory per processor. The basic research hypothesis of the subject effort was that GAPP contained sufficient hardware capability to provide a substrate for a Classifier and Genetic Algorithm system. The goal was demonstrated by constructing and running the necessary software on the GAPP, its controller and its host. The resulting fusion of software and hardware is called a Genetic Algorithm/Classifier Engine (GACE) in the same sense as a LISP engine or a database engine. The resulting quantum jump in performance should open doors both to application and to more interesting and relevant research. GRA

N90-17368# Army Materials Technology Lab., Watertown, MA. Polymer Research Branch.
REPRESENTING KNOWLEDGE INTELLIGENTLY: PRODUCTION RULES, FRAMES, AND TRANSITIONAL NETWORKS Final Report
Suzanne G. W. Dunn Oct. 1989 47 p
(DA Proj. 1L1-62105-AH-84)
(AD-A215098; MTL-TR-89-94) Avail: NTIS HC A03/MF A01 CSCL 12/9

Designs for a production rule interpreter, a frame-based knowledge system, and an augmented transitional network are described. Knowledge represented in the form of production rules (consisting of domain facts and heuristics) is a good way to model the strong data-driven nature of intelligent action. Using this knowledge, production systems make inferences on the system's current understanding of the state of the world. The production rule interpreter described uses a bottom-up approach employing a forward-chaining control strategy. Frames are complex data structures for representing stereotyped objects, events, or situations. For intelligent computer programs requiring this type of information, frame-based knowledge systems minimize redundant information and may be utilized for acquiring new information which is interpreted in terms of concepts acquired through previous experience. The frame-based system described utilizes procedural as well as declarative information. An augmented transitional network is used for natural language as well as declarative information. GRA

N90-17369# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
A MODEL FOR COMPARING GAME THEORY AND ARTIFICIAL INTELLIGENCE DECISION MAKING PROCESSES M.S. Thesis
Paul R. Andre Dec. 1989 71 p
(AD-A215418; AFIT/GSO/ENS/89D-1) Avail: NTIS HC A04/MF A01 CSCL 12/5

The purpose of this thesis was to develop an analytical tool to compare the use of an artificial intelligence decision making method to a game theory decision making method. The game theory method used was the two-player zero-sum gaming technique. The artificial intelligence method used was the minimax technique with an alpha-beta cutoff heuristic. The simulation program was written in the C programming language. The artificial intelligence method made calls to a forward chaining shell called C Language Production System, CLIPS. The original game theory method was developed by Capt Robert Palmer. It was written in Turbo Pascal and required some modification before use in this study. The program was converted to the C language, modified to fit its intended use, and fit with the artificial intelligence method described above. The program played reconnaissance satellites against ground mobile Strategic Relocatable Targets (SRTs). It implemented the methods described within this document to allow for a comparison of the two techniques. For an initial comparison, the measure of effectiveness was the number of times the satellite incorrectly predicted the SRT's movement. GRA

N90-17370# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
USE OF HYPERMEDIA AS A USER INTERFACE FOR AN ARTIFICIAL INTELLIGENCE-BASED PROBLEM SOLVER M.S. Thesis

Daniel J. Florian Dec. 1989 149 p
(AD-A215551; AFIT/GCS/ENG/89D-3) Avail: NTIS HC A07/MF A01 CSCL 12/9

The use of a hypermedia system is discussed as the user interface for an expert system. The hypermedia system allowed dynamic creation and editing of the user interface, and collected and transmitted information from the user to the expert system. The expert system, which remains transparent to the user, uses this information to recommend a solution to the problem or to determine more information is needed from the user. Regardless, the expert system communicates these results to the hypermedia system, which then displays them to the user. Specifically, the prototype developed as a part of this research was designed to help Aerospace Guidance and Metrology Center (AGMC) depot-level technicians troubleshoot the Dual Miniature Inertial Navigation Systems (DMINS) Inertial Measurement Unit (IMU), which is being used on fast attack submarines. Currently, DMINS technicians use information from automatic test equipment (ATE) to guide their troubleshooting actions. This ATE is driven entirely by test failures resulting from the tested IMU signals being out of the specification limits. In addition to using these signals, the prototype uses IMU signals, not being validated by the current test, to detect problems before a test failure occurs. The capability to find problems prior to a test failing, can significantly decrease the time needed to test an IMU. GRA

N90-17371*# Catholic Univ. of America, Washington, DC. Dept. of Mechanical Engineering.
ACTIVE CONTROL OF A FLEXIBLE STRUCTURE USING A MODAL POSITIVE POSITION FEEDBACK CONTROLLER
S. Poh and A. Baz 1990 31 p
(Grant NAG5-749)
(NASA-CR-186336; NAS 1.26:186336) Avail: NTIS HC A03/MF A01 CSCL 09B

The feasibility of a new Modal Positive Position Feedback (MPPF) strategy in controlling the vibration of a complex flexible structure using a single piezo-electric active structural member is demonstrated. The control strategy generates its control forces by manipulating only the modal position signals of the structure to provide a damping action to undamped modes. This is in contrast to conventional modal controllers that rely in their operation on negative feedback of both the modal position and velocity. The proposed strategy is very simple to design and implement as it designs the controller at the uncoupled modal level and utilizes simple first order filters to achieve the Positive Position Feedback effect. The performance of the new strategy is enhanced by augmenting it with a time sharing strategy to share a small number of actuators between larger number of modes. The effectiveness of the new strategy is validated experimentally on a flexible box-type structure that has four bays and its first two bending modes are 2.015 and 6.535 Hz respectively. A single piezo-electric actuator is utilized as an active structural member to control several transverse bending modes of the structure. The performance of the active control system is determined in the time and the frequency domains. The results are compared with those obtained when using the Independent Modal Space Control (IMSC) of Meirovitch. The experimental results suggest the potential of the proposed strategy as a viable means for controlling the vibration of large flexible structures in real time. Author

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N90-17372# International Centre for Theoretical Physics, Trieste (Italy).
APPROXIMATION METHOD FOR NONLINEAR INTEGRAL EQUATIONS OF HAMMERSTEIN TYPE
C. E. Chidume and Chika Moore (Nigeria Univ., Nsukka.) May 1989 10 p Submitted for publication
(DE90-600727; IC-89/86) Avail: NTIS (US Sales Only) HC A02/MF A01

The solution of a nonlinear integral equation of Hammerstein type in Hilbert spaces is approximated by means of a fixed point iteration method. Explicit error estimates are given and, in some cases, convergence is shown to be at least as fast as a geometric progression. DOE

N90-17373# International Centre for Theoretical Physics, Trieste (Italy).
EXISTENCE, UNIQUENESS, AND APPROXIMATION OF A SOLUTION FOR A K-POSITIVE DEFINITE OPERATOR EQUATION
C. E. Chidume and S. J. Aneke (Nigeria Univ., Nsukka.) May 1989 9 p Submitted for publication
(Grant TWAS-RG-88-14)
(DE90-600728; IC-89/87) Avail: NTIS (US Sales Only) HC A02/MF A01

The notion of a K-positive definite (K pd) operator which has been studied for Hilbert spaces is extended to real separable strictly convex Banach spaces, X. For such an X, it is proved that the equation Au = f, f (epsilon) X, where A is a K pd operator with the same domain as K, has a unique solution. Furthermore, a strongly convergent iteration process is constructed. DOE

N90-17374# Florida State Univ., Tallahassee. Dept. of Statistics.
NONPARAMETRIC ESTIMATION OF TRENDS IN LINEAR STOCHASTIC SYSTEMS
Ian W. McKeague and Tiziano Tofoni (Postgraduate School of Telecommunications, L'Aquila, Italy) Sep. 1989 25 p
(Contract DAAL03-86-K-0094)
(AD-A213741; FSU-STATISTICS-M-814; TR-107-ARO; ARO-23699.22-MA) Avail: NTIS HC A03/MF A01 CSCL 12/3

Techniques for the estimation of unknown additive trends present in the state and measurement processes of a Kalman-Bucy linear system are introduced. Asymptotic results describing the performance of the estimators under i.i.d. and periodic observation schemes were obtained. The observed process is given by dY(t) = g(t) dt + dZ(t), where Z is the measurement process and g is an unknown trend function, and there is an additive trend f present in the state process X. These two cases need to be treated separately in order to ensure identifiability. The problem is to estimate f and g, and remove them from the measurement process. Trend removal involves replacing f and g in the Kalman filter X(t) = E(X(t) FYt)-based on observation of Y-by appropriate estimates. It is shown that this can be done under the following observation schemes: (1) n i.i.d. replicates of Y over a fixed interval 0,T; and (2) observation of a single trajectory of Y over a long interval 0,NT, where f, g and the functions defining the linear system are periodic with period T. GRA

N90-17375# Laboratorio de Computacao Cientifica, Rio de Janeiro (Brazil).
ON THE SUPERCONVERGENCE OF THE SBB METHOD
Leopoldo P. Franca May 1988 29 p
(DE89-635709; LNCC-019/88; ISSN-0101-6113) Avail: NTIS (US Sales Only) HC A03/MF A01

Written in a mixed form, a simple two point boundary value problem is shown to have superconvergence characteristics under the Satisfying the Babuska-Brezzi condition method. Convergence and accuracy analyses reveal superior performance of the method compared to the usual Galerkin method. DOE

N90-17376*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
AN ENTROPY-BASED APPROACH TO NONLINEAR STABILITY
Marshal L. Merriam Mar. 1989 154 p
(NASA-TM-101086; A-89078; NAS 1.15:101086) Avail: NTIS HC A08/MF A01 CSCL 12A

Many numerical methods used in computational fluid dynamics (CFD) incorporate an artificial dissipation term to suppress spurious

oscillations and control nonlinear instabilities. The same effect can be accomplished by using upwind techniques, sometimes augmented with limiters to form Total Variation Diminishing (TVD) schemes. An analysis based on numerical satisfaction of the second law of thermodynamics allows many such methods to be compared and improved upon. A nonlinear stability proof is given for discrete scalar equations arising from a conservation law. Solutions to such equations are bounded in the L sub 2 norm if the second law of thermodynamics is satisfied in a global sense over a periodic domain. It is conjectured that an analogous statement is true for discrete equations arising from systems of conservation laws. Analysis and numerical experiments suggest that a more restrictive condition, a positive entropy production rate in each cell, is sufficient to exclude unphysical phenomena such as oscillations and expansion shocks. Construction of schemes which satisfy this condition is demonstrated for linear and nonlinear wave equations and for the one-dimensional Euler equations. Author

N90-17377# California Univ., San Diego.
FINITE WORD LENGTH CONSIDERATIONS IN HIGH RESOLUTION SPECTRAL ESTIMATION Final Report, 15 Jun. 1986 - 30 Sep. 1989
Bhaskar D. Rao Nov. 1989 35 p
(Contract DAAL03-86-K-0107)
(AD-A214684; ARO-24374.14-MA-SDI) Avail: NTIS HC A03/MF A01 CSCL 12/1

High resolution spectrum estimation methods with particular emphasis on state space based methods were evaluated. Of particular interest are finite precision effects (numerical issues), and the statistical efficiency of high resolution methods. The results are divided into and discussed under three categories: spectrum estimation, array processing, and floating point arithmetic. GRA

N90-17378# New Mexico Univ., Albuquerque.
SYMBOL MANIPULATION AND APPLIED MATHEMATICS Final Report, 15 Jul. 1985 - 14 Jul. 1989
Stanly Steinberg 15 Oct. 1989 11 p
(Contract DAAG29-85-K-0202)
(AD-A214702; ARO-21651.13-MA) Avail: NTIS HC A03/MF A01 CSCL 12/5

An algorithm was developed to symbolically compute the infinitesimal Lie symmetries of a system of partial differential equations. A theory based on simple geometric intuition was developed for using variational problems to generate numerical grids. Symbolic algorithms were developed for transforming the variational problems to FORTRAN subroutines. A theory is being developed for differencing general elliptic problems in general coordinates (needed when general numerical grids are used). Symbolic algorithms are also being developed for differencing such problems. All symbolic algorithms have been implemented in MACSYMA and some are being submitted to the MACSYMA share library. The FORTRAN code that was generated is being used in production modeling codes. GRA

N90-17379# California Univ., San Diego, La Jolla. Inst. for Cognative Science.
STRUCTURAL UNDERSTANDING IN PROBLEM SOLVING Final Report
Mary Riley 23 Oct. 1989 7 p
(Contract N00014-84-K-0579; NR Proj. 667-538)
(AD-A214776) Avail: NTIS HC A02/MF A01 CSCL 05/8

A common instructional objective in domains of math and science is the capability to use formulas and arithmetic procedures to solve problems. Although students are explicitly taught the relevant formulas and principals, are shown worked-out examples, and are given practice, they frequently experience considerable difficulty when asked to solve similar problems. Previous research suggests that difficulties often result from mechanical application of rules and formulas with little understanding of important structural relations between elements in the problem domain. The objective of this research was to analyze in greater detail what is meant by structural understanding within the domain of basic electricity, the role this understanding plays in performance and learning, and the extent to which important structural relations can be taught more directly. The research involved: (1) theoretical analyses that represent detailed hypotheses about the knowledge underlying performance in this domain, and (2) empirical studies involving the collection of verbal protocols from subjects as they learn to solve basic electricity problems under different instructional treatments. GRA

N90-17380# North Carolina Univ., Chapel Hill. Dept. of Computer Science.
SOLVING COMPUTER GRAPHICS PROBLEMS THROUGH BOOLEAN COMBINATIONS OF POLYGONS
John M. Airey Aug. 1989 14 p
(Contract N00014-86-K-0680)
(AD-A214788; TR89-031) Avail: NTIS HC A03/MF A01 CSCL 12/5

Several important computer graphics problems can be solved by formulating the problem as a boolean combination of sets of coplanar polygons. An implementation is described of an efficient plane sweep algorithm, which solves these problems by triangulating the polygonal regions defined by boolean combinations of sets of polygons. Example applications include, but are not limited to, triangulating a concave polygon with holes, computing complex clipping operations, detecting modelling errors, transforming a tiling into a planar subdivision and even the hidden surface problem. New techniques are presented to handle the difficulties encountered with real world input, which are typically omitted in presentations of geometric algorithms in the computational geometry literature. Finally, how the above applications may be cast as boolean combinations and solved with the algorithm is described. GRA

N90-17381# Computational Engineering, Inc., Laurel, MD.
SYSTEM IDENTIFICATION AND FILTERING OF NONLINEAR CONTROLLED MARKOV PROCESSES BY CANONICAL VARIATE ANALYSIS Final Report, Aug. 1988 - May 1989
Wallace E. Larimore 30 Oct. 1989 95 p
(Contract F49620-88-C-0093)
(AD-A214873; AFOSR-89-1423TR) Avail: NTIS HC A05/MF A01 CSCL 12/3

New methods are developed for the system identification and stochastic filtering of nonlinear controlled Markov processes. Currently available methods are restricted to very special forms or provide poor approximations to optimal procedures. The feasibility of using state space Markov process models and canonical variate analysis (CVA) for obtaining optimal nonlinear procedures for system identification and stochastic filtering is demonstrated. The theory of nonlinear CVA of Markov processes is developed in terms of a Hilbert space of nonlinear functions, and the multivariate nonlinear CVA is reduced to a sequential selection problem involving a univariate nonlinear CVA - the maximal correlation problem. The theory of maximal correlation, previously developed for Hilbert spaces of nonlinear functions, guarantees the existence of solutions to the multivariate CVA problem. A state space innovations representation for the Markov process is developed in terms of the canonical variable states. Extensions to the selection of a minimal rank state and interpretation of the canonical variable in terms of optimal normalizing transformations is developed. Computational algorithms are developed for determination of the canonical variable states, state space model fitting, and construction of nonlinear stochastic filters. GRA

N90-17382# Maryland Univ., College Park. Center for Automation Research.
IMAGE SMOOTHING AND DIFFERENTIATION WITH MINIMAL-CURVATURE FILTERS
Isaac Weiss Nov. 1989 39 p
(Contract N00014-89-J-1854)
(AD-A215184; CAR-TR-470; CS-TR-2341) Avail: NTIS HC A03/MF A01 CSCL 12/1

The fundamental problem of smoothing and differentiating of noisy images has been previously approached in two different

ways: (1) Minimization of a smoothness functional, a theoretically well understood procedure but one that involves the solution of a very large system of equations involving all the pixels of the image, for each image. (2) Use of small scale, ready made filters for local smoothing. The process is computationally cheap but generally ad hoc and not very reliable. This paper offers a way to combine the advantages of the two approaches. We construct general filters for local windows of the image, derived from maximization of smoothness of regularization theory. In this way the theoretically robust minimization process becomes suitable for practical implementation, possibly in real time, and is readily adaptable to local image properties. Filters for more reliable derivatives are also being derived. GRA

N90-17383# North Carolina Univ., Chapel Hill. Dept. of Statistics.
ABSOLUTE CONTINUITY AND MUTUAL INFORMATION FOR GAUSSIAN MIXTURES
Charles R. Baker and A. F. Gualtierotti (Lausanne Univ., Switzerland) Dec. 1988 30 p
(Contract N00014-89-J-1175; NSF NCR-87-13727; NR Proj. 042)
(AD-A215185; LISS-28) Avail: NTIS HC A03/MF A01 CSCL 12/9

Absolute continuity, process representations, and the Shannon information are considered for porblems involving a Gaussian mixture process (N sub t), t in (0,1). N(omega,t) = A(omega)G(omega,t) a.e. dP(omega)dt, where (G sub t) is a Gaussian process and A is a positive random variable independent of (G sub t). Let (Y sub t), t in 0,1, be a second process with nu sub Y and nu sub N the measures induced on R0,1 and mu sub Y and mu sub N the measures induced on L20,1 (Y sub t) has paths a.s. in L20.1. The Cramer-Hida spectral representation and an extension of Girsanov's theorem are used to obtain results on absolute continuity (nu sub Y much less than nu sub N and mu sub Y much less than mu sub N) and likelihood ratio in terms of similar results involving a Gaussian mixture local martingale, for which representations are given. These results are then applied to obtain the Shannon mutual information for a communication channel with feedback having (N sub t) as additive noise. Capacity is obtained for the no-feedback channel, subject to an average-energy type of constraint. GRA

N90-17384# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
SAMPLING SCATTERED DATA ONTO RECTANGULAR GRIDS FOR VOLUME VISUALIZATION M.S. Thesis
Raymond P. Lentz, III Dec. 1989 98 p
(AD-A215533; AFIT/GCE/ENG/89D-4) Avail: NTIS HC A05/MF A01 CSCL 12/5

Three dimensional arrays of scalar data representing spatial volumes arise in many scientific applications. Analysis of this type of data is difficult because of the size of the data sets. Computer graphics techniques for rendering images of three dimensional data have been developed recently. In computational fluid flow analysis, methods for constructing three dimensional numerical grids are being refined. This technique is particularly suited for simulations involving finite element analysis. The three dimensional grids produced by these methods are generally not rectangular in shape. Many graphics methods for rendering three dimensional volume images take advantage of the physical structure of rectangular grids. Because finite element analysis is useful in fields other than fluid flow analysis and the numerical grid has promising applications, methods for handling arbitrarily shaped data grids are needed. This thesis investigation develops a method for sampling data in virtually any form onto rectangular grids. Two sampling methods are developed and implemented using two different sampling filters. The results were successful in rendering images of both fabricated data and data from a fluid flow simulation. Input data distribution characteristics affecting the sampling techniques were identified, and possible solutions are provided. The goal was to determine if data could be successfully sampled from a grid of arbitrary shape onto a grid of rectangular shape. GRA

N90-17385# Naval Postgraduate School, Monterey, CA.
ON CALCULATING ANALYTIC CENTERS Report, May - Aug. 1989
Allen A. Goldstein Aug. 1989 10 p
(AD-A215635; NPS53-89-015) Avail: NTIS HC A02/MF A01 CSCL 12/1

The analytic center of a polytope can be calculated in polynomial time by Newton's method. Smale's estimates were applied at one point for Newton's method to the problem of finding the analytic center of a polytope. The method converges globally in the appropriate norm. The ideas are then applied to obtain a possible benchmark for path following methods. When Smale's method is tractable its power stems not only from the fact that the information is concentrated at one point. There are 2 norms to estimate, not 3 as in the Kantorovich estimate. Moreover no estimate of the inverse of the derivative operator by itself is needed. The need for the norm of the inverse by itself often makes for coarse estimates. GRA

N90-17386# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
BOOLEAN APPROACHES IN DIGITAL DIAGNOSIS M.S. Thesis
Reginald H. Gilyard 4 Dec. 1989 247 p
(AD-A215660; AFIT/GCS/ENG/89D-4) Avail: NTIS HC A11/MF A02 CSCL 09/1

Two existing methods that use Boolean reasoning as a basis for testing digital circuits are reviewed and improved. The method developed by Cerny to generate test vectors capable of detecting single stuck-at, bridge and multiple stuck-at faults is reviewed and then extended in two ways. The first extension incorporates the capability to automatically analyze the results gained from applying a given vector. The second extension allows the diagnosis of sequential circuits. Since Cerny's original method was not automated, the entire process is updated to include the extensions and then programmed. Kainec developed an automated diagnostic system to test for multiple faults in combinational circuits. The original system is restricted to diagnosing faults in circuits with one output. An extension is designed and programmed to incorporate the capability to diagnose multiple output circuits. The extension shows that multiple output circuits offer the added advantage of being able to choose an optimal test vector from a set of generated vectors, thereby shortening the required testing time for a given circuit. The software routines are programmed in PC-Scheme (a dialect of LISP) on an IBM microcomputer. Due to a conversion program written by Kainec the software can also be run on a Sun-4 workstation in the T environment. T is derived from Scheme. GRA

N90-17387# Naval Postgraduate School, Monterey, CA.
LOCALIZATION OF MULTIPLE BROADBAND TARGETS IN SPHERICAL COORDINATES VIA ADAPTIVE BEAMFORMING AND NON-LINEAR ESTIMATION M.S. Thesis
Richard P. Breckenridge Jun. 1989 104 p
(AD-A215714) Avail: NTIS HC A06/MF A01 CSCL 12/1

Computer simulation studies of two frequency domain adaptive beamforming algorithms for planar arrays are presented. The algorithms are modified complex least mean square adaptive algorithms that can process an arbitrary number of harmonics. The algorithms provide estimates of the spherical coordinates (i.e., range, depression angle, and bearing angle) of multiple broadband targets in both the near field and far field. Computer simulation results comparing the average estimation error for range, depression angle, and bearing angle as a function of the input signal to noise ratio, range (near field and far field), and harmonic number, are presented. The full angular coverage capability of the algorithms was also tested. GRA

N90-17388# Royal Aerospace Establishment, Farnborough (England).
THE HYPERBOLIC KEPLER'S EQUATION, AND THE ELLIPTIC EQUATION REVISITED
R. H. Gooding and A. W. Odell 4 Jul. 1989 28 p Repr. from

Celestial Mechanics (Netherlands), v. 4, 1988 p 267-282
(RAE-TM-Space-369; BR111619; ETN-90-96132) Copyright
Avail: NTIS HC A03/MF A01

A procedure for solving the hyperbolic Kepler equation is developed. Two iterations are carried out and an accuracy better than 10 to the minus 20th power is obtained (relative truncation error). The elliptic equation is extended by the development of a new procedure that solves to a maximum relative error of 10 to the minus 14th power. It is shown that a particular relative rounding error effect can also apply to the more accurate of the two solution proceding recommended for the elliptic equation. ESA

N90-17389# International Centre for Theoretical Physics, Trieste (Italy).
QUANTUM sl(2) ENVELOPING ALGEBRA AND REPRESENTATIONS OF BRAID GROUP
Zhong-Qi Ma Jul. 1989 17 p Presented at the 13th Johns Hopkins Workshop on Current Problems in High Energy Particle Theory, Florence, Italy, 1989
(DE90-607044; IC-89/162) Avail: NTIS (US Sales Only) HC A03/MF A01

In this note we review the relation between the Yang-Baxter equation and the braid group briefly. We discuss the quantum sl(2) enveloping algebra systematically, and present a general method to obtain a representation of the braid group from a solution of the classical Yang-Baxter equation based on a representation of a quantum simple Lie enveloping algebra. DOE

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N90-17390# Laboratorio de Computacao Cientifica, Rio de Janeiro (Brazil).
ON SCATTERING BY TIME-DEPENDENT POTENTIALS: THE 2-D CASE
J. Arminio Ferreira (Universidade Federal do Espirito Santo, Vitoria, Brazil) and G. Perla Menzala May 1988 29 p
(DE89-635708; LNCC-018/88) Avail: NTIS (US Sales Only) HC A03/MF A01

A real potential q(x,t) which has compact support in space x epsilon IR(sup 2) and is damped is considered. The solutions of U sub (tt) - delta u + q(x,t)u = 0 showing that under additional technical assumptions on q the scattering operator exists are studied. The proofs are elementary. DOE

N90-17391*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A DOPPLER CENTROID ESTIMATION ALGORITHM FOR SAR SYSTEMS OPTIMIZED FOR THE QUASI-HOMOGENEOUS SOURCE
Michael Y. Jin 1 Oct. 1989 52 p
(Contract NAS7-918)
(NASA-CR-186229; JPL-Publ-89-9; NAS 1.26:186229) Avail: NTIS HC A04/MF A01 CSCL 12A

Radar signal processing applications frequently require an estimate of the Doppler centroid of a received signal. The Doppler centroid estimate is required for synthetic aperture radar (SAR) processing. It is also required for some applications involving target motion estimation and antenna pointing direction estimation. In some cases, the Doppler centroid can be accurately estimated based on available information regarding the terrain topography, the relative motion between the sensor and the terrain, and the antenna pointing direction. Often, the accuracy of the Doppler centroid estimate can be improved by analyzing the characteristics of the received SAR signal. This kind of signal processing is also referred to as clutterlock processing. A Doppler centroid estimation (DCE) algorithm is described which contains a linear estimator optimized for the type of terrain surface that can be modeled by a quasi-homogeneous source (QHS). Information on the following topics is presented: (1) an introduction to the theory of Doppler centroid estimation; (2) analysis of the performance characteristics of previously reported DCE algorithms; (3) comparison of these analysis results with experimental results; (4) a description and performance analysis of a Doppler centroid estimator which is optimized for a QHS; and (5) comparison of the performance of the optimal QHS Doppler centroid estimator with that of previously reported methods. Author

N90-17392# Scripps Institution of Oceanography, La Jolla, CA. Marine Physical Lab.
STATISTICS OF A CHI-SQUARE RANDOM VARIABLE OBTAINED FROM INDEPENDENT GAUSSIAN SAMPLES WITH A NON-ZERO MEAN AND ARBITRARY VARIANCE
Richard K. Brienzo Jan. 1989 11 p
(Contract N00014-80-C-0220)
(AD-A214477; MPL-TM-405; MPL-U-40/88) Avail: NTIS HC A03/MF A01 CSCL 12/3

The mean and variance of a chi-square random variable are generally given for the case in which the chi-square random variable is derived from a process having a zero mean and unit variance. In this report, the mean and variance of the random variable found by squaring and summing N samples of an independent Gaussian process with a non-zero mean and arbitrary variance is derived. GRA

N90-17393# Stanford Univ., CA. Information Systems Lab.
STUDIES IN STATISTICAL SIGNAL PROCESSING Annual Report, 1 Jul. 1988 - 30 Jun. 1989
Thomas Kailath 1 Aug. 1989 24 p
(Grant AF-AFOSR-0327-88; AF Proj. 2304)
(AD-A214490; AFOSR-89-1353TR) Avail: NTIS HC A03/MF A01 CSCL 12/3

The primary objective of our research is to develop efficient and numerically stable algorithms for nonstationary signal processing problems by understanding and exploiting special structures, both deterministic and stochastic, in the problems. We also strive to establish and broaden links with related disciplines, such as cascades filter synthesis, scattering theory, numerical linear algebra, and mathematical operatory theory for the purpose of cross fertilization of ideas and techniques. These explorations have led to new results both in estimation theory and in these other fields, e.g., to new algorithms for triangular and QR factorization of structured matrices, new techniques for root location and stability testing, and new recursions for orthogonal polynomials on the unit circle and the real line as well as on other curves. GRA

N90-17394# George Mason Univ., Fairfax, VA. School of Information Technology and Engineering.
A FURTHER NOTE ON GENERALIZED HYPEREXPONENTIAL DISTRIBUTIONS
Carl M. Harris, William G. Marchal, and Robert F. Botta 15 Nov. 1989 22 p
(Contract N00014-86-K-0029)
(AD-A214881; GMU/22474/112) Avail: NTIS HC A03/MF A01 CSCL 12/3

Many authors have used distribution functions related to the exponential staging formulation introduced by Erlang (see Brockmeyer et al., 1948), with primary modifications over the years by Jensen (1954) and Cox (1955). Much of the current popularity of such distributions is due to the work of Neuts and colleagues on the so-called phase-type family, exploiting relationships to the theory of Markov chains and putting the theory to effective computational use in a large variety of stochastic models. For purposes of clarity, the following relationships is noted between these classes of cumulative distribution functions (CDFs). Essentially, all of this stems from Erlang's early idea of modeling a duration or lifetime as a sum of independent and identical exponential stages. Much later, Jensen (1954) generalized Erlang's device to allow the stages to have non-identical CDFs, and indeed recognized the natural connection between Erlang's method of stages and absorption-time distributions of finite Markov chains. GRA

N90-17395# Naval Postgraduate School, Monterey, CA. Dept. of Operations Research.
THREE POSITION ESTIMATION PROCEDURES
R. N. Forrest Apr. 1989 38 p Revised
(AD-A214992; NPS55-84-13-Rev-2) Avail: NTIS HC A03/MF A01 CSCL 12/3

The report describes three position estimation procedures. The first is for combining estimates from different sources into a composite position estimate. The second is for generating a position estimate from bearing on or from two or more locations. The third is for generating a position estimate from two or more lines of bearing. The second revision represents a complete restructing of the report. In addition to containing corrections to several errors that are present in the original version, it also contains revised versions of the two programs that they contain. GRA

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N90-17396*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
AN ANALYSIS OF SCATTER DECOMPOSITION Final Report
David M. Nicol and Joel H. Saltz Jan. 1990 21 p Submitted for publication
(Contracts NAS1-18107; NAS1-18605; N00014-86-K-0310; NSF ASC-88-19373; NSF DCR-81-06181)
(NASA-CR-181978; NAS 1.26:181978; ICASE-90-4) Avail: NTIS HC A03/MF A01 CSCL 12B

A formal analysis of a powerful mapping technique known as scatter decomposition is presented. Scatter decomposition divides an irregular computational domain into a large number of equal sized pieces, and distributes them modularly among processors. A probabilistic model of workload in one dimension is used to formally explain why, and when scatter decomposition works. The first result is that if correlation in workload is a convex function of distance, then scattering a more finely decomposed domain yields a lower average processor workload variance. The second result shows that if the workload process is stationary Gaussian and the correlation function decreases linearly in distance until becoming zero and then remains zero, scattering a more finely decomposed domain yields a lower expected maximum processor workload. Finally it is shown that if the correlation function decreases linearly across the entire domain, then among all mappings that assign an equal number of domain pieces to each processor, scatter decomposition minimizes the average processor workload variance. The dependence of these results on the assumption of decreasing correlation is illustrated with situations where a coarser granularity actually achieves better load balance. Author

N90-17397# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
AN EXPLORATION OF ISSUES RELATED TO FUTURE SPACE LOGISTICIANS M.S. Thesis
Stewart G. Carr Sep. 1989 202 p
(AD-A215374; AFIT/GLM/LSM/89S-6) Avail: NTIS HC A10/MF A02 CSCL 22/1

The purpose of this research was to explore the space logistics arena for issues related to space logistician development, that require further research. The study specifically looked at qualifications, training, maintenance, and future requirements to determine areas that may require advanced preparation in the development of future logisticians. The study found that there are no specific qualifications peculiar to space logistics. Experience and an understanding of the space environment were seen as the most desirable qualities. However, the personnel system does not allow the space logistician to gain enough experience before they are moved, and the lack of training for new space logisticians severely hampers their usefulness. The future requirements for space logisticians is increasing. The Air Force role in space projected to increase significantly over the next decade and a space logistics infrastructure needs to be developed now if the Air Force is to meet its own needs. Such issues as organic launch capability and on-orbit maintenance and support are serious future requirements for the Air Force. GRA

N90-17398# Air Univ., Maxwell AFB, AL. Airpower Research Inst.
DEFENDING AGAINST A SPACE BLOCKADE: CADRE PAPER
Tom Blow Dec. 1989 24 p
(AD-A215681; AU-ARI-CP-89-3) Avail: NTIS HC A03/MF A01 CSCL 15/3

Although great attention has been paid to space weapons in relation to the Strategic Defense Initiative, there seems to be little recognition that platforms performing an SDI role could establish a space blockade. The United States must recognize the feasibility of such a blockade and take steps to offset it. Possible steps include depending on arms control pacts to keep weapons out of space, developing terrestrial systems for use in breaking a blockade, or putting weapons in space before an adversary can establish a blockade. Problems in verifying the nature of orbiting vehicles reduce the reliability of arms control. Advantages space weapons will have over surface-based systems argue against dependence on restorative measures undertaken from the ground. Thus, putting weapons in space is an option that should be explored. Perhaps the most cogent argument against this option is that using space for military ends may be destabilizing. Merely placing U.S. weapons in low orbit, even if they were deployed solely for SDI, would threaten rivals because of the possibility of a U.S. blockade. Moreover, such platforms would be vulnerable if another power put weapons in orbit. However, a mix of low orbit SDI forces and high orbit reserve forces should be less vulnerable and less threatening. Such a defense could be improved by creating a high orbit keep-out zone for each space power. GRA

N90-17399# Technical Planning, Inc., Bethesda, MD.
UNITED STATES DEPARTMENT OF ENERGY STATEGIC DEFENSE INITIATIVE: NEW AND INNOVATIVE CONCEPTS PROGRAM Summary Report
Oct. 1989 115 p
(Contract DE-AP03-89FF-1820)
(DE90-005006; DOE/FF-18204/T1) Avail: NTIS HC A06/MF A01

The Department of Energy's New and Innovative Concepts (N and IC) Program was established in FY1985 as part of the joint program between the Department of Defense and the DOE for strategic defense research and technology development outlined in the FY1984 Memorandum of Agreement between the two agencies. The purpose of the N and IC Program was to elicit revolutionary (rather than evolutionary) concepts, approaches, and ideas from the nation's scientific community. Three public PRDAs and one national laboratory-directed solicitation were issued seeking participation of universities, large and small businesses, nonprofit organizations, and the national laboratories. The purpose of this report is to present summaries of the forty-two funded state-of-the-art N and IC projects and is intended as an aid in the transfer of the technical results to the scientific community involved in Strategic Defense Initiative (SDI) activities. The potential benefits from this information transfer include the application of N and IC project results to other fields and projects, and the further development of these specific projects by other government and private entities. DOE

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N90-17400# Laboratorio de Computacao Cientifica, Rio de Janeiro (Brazil).
ASYMPTOTIC BEHAVIOUR OF SOLUTIONS OF A DEGENERATE QUASILINEAR HYPERBOLIC EQUATION

Ducival C. Pereira (Universidade Federal do Para, Brazil) Oct. 1988 12 p Submitted for publication
(DE89-635713; LNCC-036/88; ISSN-0101-6113) Avail: NTIS (US Sales Only) HC A03/MF A01

The decay as t approaches infinity of the solutions of the equation u''(t) + (the absolute value of A(sup 1/2) u(t)(sup 2)) Au(t)+Au'(t)=0 where A is a self-adjoint operator in a Hilbert space H, is studied. A decay of algebraic rate for the energy associated to the studied equation is obtained. The asymptotic behavior of the solutions of the problem are studied. The equation is an abstract model for an equation which describes the motion of an elastic string with strong damping. DOE

N90-17401*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
A KINETIC EQUATION WITH KINETIC ENTROPY FUNCTIONS FOR SCALAR CONSERVATION LAWS Final Report
Benoit Perthame and Eitan Tadmor (Tel-Aviv Univ., Israel) Jan. 1990 21 p Submitted for publication
(Contract NAS1-18605; BSF-85-00346)
(NASA-CR-181985; NAS 1.26:181985; ICASE-90-11) Avail: NTIS HC A03/MF A01 CSCL 12A

A nonlinear kinetic equation is constructed and proved to be well-adapted to describe general multidimensional scalar conservation laws. In particular, it is proved to be well-posed uniformly in epsilon - the microscopic scale. It is also shown that the proposed kinetic equation is equipped with a family of kinetic entropy functions - analogous to Boltzmann's microscopic H-function, such that they recover Krushkov-type entropy inequality on the macroscopic scale. Finally, it is proved by both - BV compactness arguments in the one-dimensional case, that the local density of kinetic particles admits a continuum limit, as it converges strongly with epsilon below 0 to the unique entropy solution of the corresponding conservation law. Author

N90-17402# International Centre for Theoretical Physics, Trieste (Italy).
HARMONIC MAPPINGS INTO MANIFOLDS WITH BOUNDARY
Yun Mei Chen and R. Musina Aug. 1989 35 p Submitted for publication
(DE90-606961; IC-89/217) Avail: NTIS (US Sales Only) HC A03/MF A01

In this paper we deal with harmonic maps from a compact Riemannian manifold into a manifold with boundary. In this case, a weak harmonic map is by definition a solution to a differential inclusion. In the first part of the paper we investigate the general properties of weak harmonic maps, which can be seen as solutions to a system of elliptic differential equations. In the second part we concentrate our attention on the heat flow method for harmonic maps. The result we achieve in this context extends a result by Chen and Struwe. DOE

70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

N90-17403*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
PERMANENT MAGNET FLUX-BIASED MAGNETIC ACTUATOR WITH FLUX FEEDBACK Patent Application
Nelson J. Groom, inventor (to NASA) 11 Sep. 1989 17 p Sponsored by NASA
(NASA-Case-LAR-13785-1; NAS 1.71:LAR-13785-1; US-Patent-Appl-SN-405168) Avail: NTIS HC A03/MF A01 CSCL 20C

The invention is a permanent magnet flux-biased magnetic actuator with flux feedback for adjustably suspending an element on a single axis. The magnetic actuator includes a pair of opposing electromagnets and provides bi-directional forces along the single axis to the suspended element. Permanent magnets in flux feedback loops from the opposing electromagnets establish a reference permanent magnet flux-bias to linearize the force characteristics of the electromagnets to extend the linear range of the actuator without the need for continuous bias currents in the electromagnets. NASA

N90-17404# California Univ., San Diego, La Jolla. Dept. of Physics.
[A NEW APPROACH FOR THE UTILIZATION OF ELECTRON PARAMAGNETIC RESONANCE AND AN INVESTIGATION OF COPPER OXIDE SUPERCONDUCTORS] Final Technical Report, 1 Nov. 1988 - 31 Oct. 1989
Sheldon Schultz 6 Oct. 1989 10 p
(Contract N00014-87-K-0338)
(AD-A213833) Avail: NTIS HC A02/MF A01 CSCL 20/3

Two problems are discussed. The first is a new approach to utilize electron paramagnetic resonance (EPR) as a probe of electron transport across a silicon-metal interface. The second is an investigation of the important properties of the copper-oxide high T sub c superconductors. With respect to the first problem, special P-doped silicon samples are discussed, and techniques for maintaining an atomically clean silicon surface in ultrahigh vacuum (UHV) without high temperature processing were developed. A proof of concept is provided for samples made in UHV but, of necessity, measured in a separate EPR apparatus. The investigation of copper-oxide superconductivity involved a detailed look into the magnetic properties of single crystals of the family R2CuO4(R=Pr, Nd, Sm, Eu, or Gd). This system was shown to become superconducting when doped with Ce or Th. It is particularly interesting because the Cu-O is purely planar and is claimed to have electron conductivity. The complex magnetic behavior observed, which includes antiferromagnetic transitions, weak ferromagnetism, anomalous anisotropy, spin canting, and spontaneous spin reorientation is described. GRA

N90-17405# Texas Univ., Arlington. Wave Scattering Research Center.
SIMULATION OF ROUGH SURFACE SCATTERING IN THREE-DIMENSIONS Quarterly Report, 16 May 1989 - 15 Aug. 1989
A. K. Fung and P. M. Chen 15 Aug. 1989 11 p
(Contract N00014-87-K-0751)
(AD-A215171) Avail: NTIS HC A02/MF A01 CSCL 20/3

The standard iterative approach has been used to solve the integral equation for the surface current density on a perfectly conducting surface. The number of iterations necessary was established to be only one to obtain a good agreement (within 1dB) between the iterative method and the standard moment method when the incidence angle was smaller than 60 degrees and the rms slope smaller than 0.4. While three-dimensional surface scattering problem can be solved with this method, it was found to be time consuming. For this reason further study has been made to look for a more effective method by finding an optimum basis function to represent the unknown field. During the past quarter a spectral representation was used to represent the scattered field and the tangenital boundary condition was used to determine the scattered field directly. Initial test was carried out for a two-dimensional surface scattering problem. It was found that an hour calculation on VAX 8700 using the standard moment method could be reduced to 3 minutes with the present technique. GRA

N90-17406# Royal Aerospace Establishment, Farnborough (England).
ON UNIVERSAL ELEMENTS, AND CONVERSION PROCEDURES TO AND FROM POSITION AND VELOCITY
R. H. Gooding Jul. 1989 30 p Repr. from Celestial Mechanics (Netherlands) v. 44, 1988 p 283-298
(RAE-TM-Space-370; BR110991; ETN-90-96133) Copyright Avail: NTIS HC A03/MF A01

An element set, applicable to all types of orbit without loss of accuracy, is analyzed. It is not free of singularity. Conversion

procedures, to and from position and velocity, are outlined, with FORTRAN-77 listings appended. Tests indicate that the errors in the pair of procedures are minimal. The accuracy is limited only by computer precision and the (fixed) number of iterations used in the Kepler equation solutions. The universality objective (for an element set) is concluded to be incompatible with freedom from singularity. The existence of singularities for a universally applicable set is not a major defect. ESA

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environmental Pollution*.

N90-17407*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
GENERALIZED PULSE EQUATIONS FOR THROUGH-TRANSMISSION EVALUATION OF ARBITRARY MULTILAYERED STRUCTURES
E. James Chern and Hatsumi T. C. Nielsen (Stanford Univ., CA.) Jan. 1990 28 p
(NASA-TM-100752; Rept-90B00056; NAS 1.15:100752) Avail: NTIS HC A03/MF A01 CSCL 20A

Generalized transit time and pulse amplitude equations were derived for modelling the ultrasonic through-transmission wave propagation of an arbitrary n-layered structure. The equations can be programmed into an expert system and used to identify and predict the through-transmission pulse signals from the critical interfaces of a multilayered structure. To test the formulas, the through transmission was measured from one- and three-layered configurations in the laboratory. The experimental measurements were compared with computer-generated data determined using the derived equations. The results verify the validity of the formulas. Author

N90-17408*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
METHOD AND APPARATUS FOR CHARACTERIZING REFLECTED ULTRASONIC PULSES Patent Application
William T. Yost, inventor (to NASA) and John H. Cantrell, inventor (to NASA) 17 Oct. 1989 32 p
(NASA-Case-LAR-13966-1; NAS 1.71:LAR-13966-1; US-Patent-Appl-SN-422726) Avail: NTIS HC A03/MF A01 CSCL 20A

The invention is a method of and apparatus for characterizing the amplitudes of a sequence of reflected pulses R1, R2, and R3 by converting them into corresponding electric signals E1, E2, and E3 to substantially the same value during each sequence thereby restoring the reflected pulses R1, R2, and R3 to their initial reflection values by timing means, an exponential generator, and a time gain compensator. Envelope and baseline reject circuits permit the display and accurate location of the time spaced sequence of electric signals having substantially the same amplitude on a measurement scale on a suitable video display or oscilloscope. NASA

N90-17409# BBN Systems and Technologies Corp., Canoga Park, CA.
NOISE AND SONIC BOOM IMPACT TECHNOLOGY. EFFECTS OF AIRCRAFT NOISE AND SONIC BOOMS ON STRUCTURES: AN ASSESSMENT OF THE CURRENT STATE-OF-KNOWLEDGE Final Report, Sep. 1987 - Aug. 1988
Jerald M. Haber, David Nakaki, Craig Taylor, George Knipprath, Vijay Kopparam, and Mark Legg Feb. 1989 99 p
(Contract F33615-86-C-0530; AF Proj. 3037)
(AD-A213919; BBN-6830; HSD-TR-89-002) Avail: NTIS HC A05/MF A01 CSCL 20/1

A comprehensive literature search was performed regarding the effect of aircraft noise and sonic boom on structures. The initial phase of this search identified approximately 2,500 citations that were reviewed for suitability for the Assessment System for Aircraft Noise (Asan); 635 citations were selected for inclusion in the ASAN citation database. Of those citations included, 144 were identified to be of sufficient importance to include abstracts in the database. Critical reviews for 40 citations appear within the database; 4 of these citations are controversial and were reviewed by three independent reviewers. The remaining articles cover the following topics: conventional structures, cumulative damage, terrain effects, metastructural effects, unconventional structures, and low frequency noise effects. This report documents the methodology used to develop the database. In addition, it presents a synopsis of what is known about the effects of aircraft noise and sonic boom on structures, and identifies the technology gaps for each of the listed topics. GRA

N90-17410# BBN Systems and Technologies Corp., Canoga Park, CA.
NOISE AND SONIC BOOM IMPACT TECHNOLOGY. INITIAL DEVELOPMENT OF AN ASSESSMENT SYSTEM FOR AIRCRAFT NOISE (ASAN). VOLUME 1: EXECUTIVE SUMMARY Final Report, 12 Feb 1987 - 31 Jul. 1989
Sanford Fidell, Nicolaas Reddingius, Michael Harris, and Andrew B. Kugler Jun. 1989 24 p
(Contract F33615-86-C-0530)
(AD-A214164; BBN-6624-Vol-1; HSD-TR-89-010-Vol-1) Avail: NTIS HC A03/MF A01 CSCL 20/1

This is the first volume of a four volume report describing the development of a preliminary prototype version of an Assessment System for Aircraft Noise (ASAN). ASAN is a software system intended to assist members of the United States Air Force environmental planning community to comply with noise-related aspects of the environment impact assessment process required by the National Environmental Policy Act (NEPA) of 1969 and other regulations. GRA

N90-17411# BBN Systems and Technologies Corp., Canoga Park, CA.
NOISE AND SONIC BOOM IMPACT TECHNOLOGY. INITIAL DEVELOPMENT OF AN ASSESSMENT SYSTEM FOR AIRCRAFT NOISE (ASAN). VOLUME 2: SYSTEM DESIGN STRATEGY Final Report, 12 Feb. 1987 - 31 Jul. 1989
Sanford Fidell, Nicolaas Reddingius, Michael Harris, and B. Andrew Kugler Jun. ,1989 57 p
(Contract F33615-86-C-0530; AF Proj. 3037)
(AD-A214454; HSD-TR-89-010-Vol-2) Avail: NTIS HC A04/MF A01 CSCL 12/7

This is the second volume of a four volume report summarizing the development and current contents of a preliminary prototype version of an Assessment System for Aircraft Noise (ASAN). ASAN is a computer-based system intended to assist members of the United States Air Force (USAF) environmental planning community in addressing noise-related issues in developing environmental impact analysis documents, in compliance with USAF and other regulations, especially the National Environmental Policy Act (NEPA) of 1969. This volume describes the development and capabilities of the preliminary prototype version of ASAN and recommends actions needed to develop a final prototype version. GRA

N90-17412# BBN Systems and Technologies Corp., Canoga Park, CA.
NOISE AND SONIC BOOM IMPACT TECHNOLOGY. INITIAL DEVELOPMENT OF AN ASSESSMENT SYSTEM FOR AIRCRAFT NOISE (ASAN). VOLUME 3: TECHNICAL DESCRIPTION Final Report, 12 Feb. 1987 - 31 Jul. 1989
Sanford Fidell, Nicolaas Reddingius, Michael Harris, and B. Andrew Kugler Jun. 1989 229 p
(Contract F33615-86-C-0530; AF Proj. 3037)
(AD-A214455; HSD-TR-89-010-Vol-3) Avail: NTIS HC A11/MF A02 CSCL 12/5

This is the third volume report summarizing the development and current contents of a preliminary prototype version of an Assessment System for Aircraft Noise (ASAN). ASAN is a computer-based system intended to assist members of the United States Air Force (USAF) environmental impact analysis documents,

in compliance with USAF and other regulations, especially the National Environmental Policy ACT (NEPA) of 1969. This volume contains the specifications for the preliminary prototype ASAN software. GRA

N90-17413*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
PREDICTED AND MEASURED BOUNDARY LAYER REFRACTION FOR ADVANCED TURBOPROP PROPELLER NOISE
James H. Dittmar and Eugene A. Krejsa Jan. 1990 20 p
(NASA-TM-102365; E-5081; NAS 1.15:102365) Avail: NTIS HC A03/MF A01 CSCL 20A

Currently, boundary layer refraction presents a limitation to the measurement of forward arc propeller noise measured on an acoustic plate in the NASA Lewis 8- by 6-Foot Supersonic Wind Tunnel. The use of a validated boundary layer refraction model to adjust the data could remove this limitation. An existing boundary layer refraction model is used to predict the refraction for cases where boundary layer refraction was measured. In general, the model exhibits the same qualitative behavior as the measured refraction. However, the prediction method does not show quantitative agreement with the data. In general, it overpredicts the amount of refraction for the far forward angles at axial Mach number of 0.85 and 0.80 and underpredicts the refraction at axial Mach numbers of 0.75 and 0.70. A more complete propeller source description is suggested as a way to improve the prediction method. Author

N90-17414# Naval Underwater Systems Center, Newport, RI.
UNDERWATER ACOUSTIC SCATTERING FROM SPHERICAL PARTICULATES AND BUBBLES Final Report
K. B. Sullivan-Silva 1 Nov. 1989 59 p
(AD-A214827; NUSC-TR-6772) Avail: NTIS HC A04/MF A01 CSCL 20/1

High frequency underwater acoustic scattering from spherical particulates is examined theoretically for purposes of comparison with available data to develop conclusions on the types and magnitudes of scattering in various geographical regions. The simplifying assumptions of an ideal fluid sphere and isotropic medium conditions are employed in the derivation of the theoretical particulate scattering model. This theory is detailed here and also presented in the form of scattering plots generated by a computer model developed in this study to facilitate accurate analysis of individual scatterers. Special theoretical cases are presented and examined, including those of a large sphere, a small sphere, a rigid sphere (highly incompressible), and a gas bubble (highly compressible), for which additional consideration of damping effects is provided. GRA

N90-17415# Pennsylvania State Univ., State College.
SURFACE ACOUSTIC WAVE SENSORS AND PIEZOELECTRIC ACTUATORS FOR INVESTIGATIONS OF TRANSITIONAL AND TURBULENT FLOWS Quarterly Report, 1 Jul. - 31 Oct. 1989
Vasundara V. Vardan, Wayne R. Pauley, and Vijay K. Varadan 31 Oct. 1989 3 p
(Contract N00014-89-J-3102)
(AD-A214889) Avail: NTIS HC A01/MF A01 CSCL 09/4

The objective of this proposal is to: (1) use global and local surface acoustic wave (SAW) devices as sensors to characterize the spatial and temporal fluctuations of the normal and shear stresses at a wall exposed to turbulent flow; (2) study the effect of piezoelectric actuators on the flow field and quantify the changes introduced by characterizing the flow downstream; (3) investigate the possibility of using the signals from the sensor to excite the actuators with appropriate feedback loops and signal processing to suppress or eliminate undesirable features in the flow field that lead to increase drag and radiated noise; in other words develop a smart skin. Conventional sensors, such as digital imaging with bubble photographs, 3-D LDA and hot wire probes will be used to compare the results from SAW sensors. GRA

N90-17416# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
BULK ACOUSTIC WAVE RESONATORS MADE OF AMORPHOUS MATERIALS Ph.D. Thesis - Paris 6 Univ. [RESONATEURS A ONDES ELASTIQUES DE VOLUME EN MATERIAUX AMORPHES]
Michel Breuzet 1988 181 p In FRENCH; ENGLISH summary
(ONERA-NT-1989-4; ISSN-0078-3781; ETN-90-96209) Avail: NTIS HC A09/MF A01

Radio frequency vibrating plates made of amorphous conductive materials are characterized. Capacitive excitation is used. The advantages of using the so called Lame mode is demonstrated. Finite element method calculations are used to minimize resonator mounting coupling and increase the quality factor. Experimental work on aluninum alloys and vitreus silica results in up to 4 million quality factor at room temperature and 200 kHz, and up to 5 million at cryogenic temperatures. ESA

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N90-17417*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A COVARIANT MULTIPLE SCATTERING SERIES FOR ELASTIC PROJECTILE-TARGET SCATTERING
Franz Gross and Khin Maung-Maung (Hampton Univ., VA.) [1989] 43 p Prepared in cooperation with College of William and Mary, Williamsburg, VA
(Contract NAG1-477; DE-AC05-84ER-40150)
(NASA-TM-101942; NAS 1.15:101942; CEBAF-PR-89-036; WM-89-109) Avail: NTIS HC A03/MF A01 CSCL 20H

A covariant formulation of the multiple scattering series for the optical potential is presented. The case of a scalar nucleon interacting with a spin zero isospin zero A-body target through meson exchange, is considered. It is shown that a covariant equation for the projectile-target t-matrix can be obtained which sums the ladder and crossed ladder diagrams efficiently. From this equation, a multiple scattering series for the optical potential is derived, and it is shown that in the impulse approximation, the two-body t-matrix associated with the first order optical potential is the one in which one particle is kept on mass-shell. The meaning of various terms in the multiple scattering series is given. The construction of the first-order optical potential for elastic scattering calculations is described. Author

N90-17418# State Univ. of New York, Stony Brook. Dept. of Physics.
LASER COOLING OF NEUTRAL ATOMS Final Report, 22 Jul. 1983 - 30 Sep. 1988
Harold Metcalf Oct. 1989 24 p
(Contract N00014-83-K-0585)
(AD-A214440) Avail: NTIS HC A02/MF A01 CSCL 20/5

A new cooling process was discovered that uses an applied magnetic field to mix differentially light shifted atomic ground state sublevels. It seems to be another form of the polarization scrambling molasses that was appropriate for the ultra-cold measurements on the 3-D Na molasses at the NBS last year, except that this is a 1-D (or perhaps 2-D) version. Optical collimation experiments were performed in 2-D to make a very intense beam of atoms. Measuring a beam profile in 2-D would require two hot wires scanning in perpendicular directions, and any asymmetry in the line shape could produce ambiguity. It is therefore very desirable to have a neutral atom imaging device. GRA

N90-17419# Missouri Univ., Rolla. Dept. of Chemistry.
NMR MEASUREMENTS OF SOLVENT SELF-DIFFUSION COEFFICIENTS IN POLYMER SOLUTIONS Interim Report, Nov. 1987 - Nov. 1989
Frank D. Blum, Stephen Pickup, and R. Allen Waggoner 28 Nov. 1989 4 p

(Contract N00014-88-K-0109)
(AD-A215276; UMR-FDB-13) Avail: NTIS HC A01/MF A01 CSCL 07/6

The transport of solvents and other small molecules in polymer solutions is important in many areas such as reaction rates, drying of coatings, plasticizer loss, curing of resins, elimination of residual monomer, and controlled drug release. Some of the work done in our laboratory on the diffusion of small molecules in polymer solutions and dispersions is reviewed. The diffusion data was used to test the Vrentas and Duda's free-volume theory for self-diffusion coefficients; test the independence of the normalized solvent self-diffusion for several polymer-solvent systems; and predict the solvent loss curves for drying of coatings based on solvent self-diffusion coefficients. GRA

N90-17420# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
DIRECT MEASUREMENTS OF THE PHYSICAL DIFFUSION OF REDOX ACTIVE SPECIES: MICROELECTROCHEMICAL EXPERIMENTS AND THEIR SIMULATION Technical Report No. 33, 1 Jul. - 1 Oct. 1989
Stuart Licht, Vince Commarata, and Mark S. Wrighton 1 Oct. 1989 52 p Submitted for publication
(Contract N00014-84-K-0553)
(AD-A215680) Avail: NTIS HC A04/MF A01 CSCL 07/4

A method is presented for direct measurement of physical diffusion of molecular species in solution. Movement of a small number of species in solution can be tracked as a function of space and time by using an array of individually addressable microelectrodes. The arrays typically consist of 8 parallel microelectrodes approx. 50 x 2.7 microns x approx. 0.1 microns separated from each other by approx. 1.4 microns. Experimental studies involve electrochemical generation of as few as 6 x 10(exp -20) power moles of redox active species at one microelectrode (generator) and electrochemical detection of a significant percentage of these species at other microelectrodes (collection) 0.8 to 26 microns away. Measurements involve determining the time dependence of the collector current associated with detection of the diffusing species produced in short and long pulses at the generator. Microelectrochemical experiments and numerical simulations are presented to show that the time dependence of the collector current allows determination of the diffusion coefficient of the diffusing species. For the geometries of generator and collector used, an important relationship for short generator pulses is t(mt) = 0.22 (d sq)/D where t(mt) is the time associated with the peak in the collector current, d the distance from the center of the generator to the nearest edge of the collector, and D the diffusion coefficient. Thus, by knowing d and measuring t(mt), D can be determined for a species generated at one microelectrode and detected at another. GRA

N90-17421# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
SINGLET OXYGEN AND IODINE MONOFLUORIDE COLLISIONAL ENERGY TRANSFER MECHANISM M.S. Thesis
Robert T. Mack Dec. 1989 67 p
(AD-A215711; AFIT/GEP/ENP/89D-8) Avail: NTIS HC A04/MF A01 CSCL 07/4

The reaction between singlet oxygen (O2(a) and O2(b)) and iodine monofluoride (IF) occurring in a flowing reactor was observed as a means to study the energy transfer mechanism between these two molecules. Several researchers have demonstrated that singlet oxygen will efficiently pump IF(X) to the IF(B) state, however the exact mechanism has not been determined. The purpose of this research was twofold. First is to identify IF(B) emission due to pumping by O2(b) emission intensity as a function of the concentration of the individual reactants. The IF(B) emission spectrum indicates that O2(b) pumping of IF(X) to the IF(A') state cannot be discounted. Quenching coefficients for IF precursors are presented and compared to literature values. GRA

N90-17422# State Univ. of New York, Buffalo. Dept. of Chemistry.
SQUEEZING OF MANY-ATOM RADIATION IN AN OPTICAL CAVITY
Fu-Li Li (Xian Jiaotong Univ., China), Xiao-Shen Li, D. L. Lin, and Thomas F. George Nov. 1989 34 p Submitted for publication
(Contract N00014-86-K-0043)
(AD-A215736; UBUFFALO/DC/89/TR-119) Avail: NTIS HC A03/MF A01 CSCL 09/3

A method developed in terms of the SU(2) Lie algebra for the treatment of many-level atoms is now modified to treat the system of many two-level atoms interacting with a cavity field. Spectral attention is given to field squeezing up to fourth order. The effects of the number of atoms and detuning on the squeezing are investigated numerically for various initial field intensities. It is found that the atomic cooperation enhances the squeezing, while in the case of weak excitation, it weakens the squeezing. The possibility of constructing many-atom micromasers is suggested. In a micromaser, inversely populated atoms are injected one by one into an optical cavity to create stimulated emission. It is suggested that a many-atom maser may be designed in which a group of active atoms instead of one is injected into the cavity at one time. If such many-atom micromasers are realized, it should be much easier to observe the field squeezing with strong initial excitation. It is known that a micromaser may be expected to produce low noise microwave radiation. If the active medium consists of only one atom, its output power is too small to be useful for any practical purpose. If, however, the active medium consists of a group of atoms, or a large number of atoms is allowed to pass the cavity at one time, the output power of the micromaser will be greatly increased. GRA

N90-17423# Lawrence Livermore National Lab., CA.
GENERATION OF H-, H2v(DOUBLE PRIME), AND H ATOMS BY H2+ AND H3+ IONS INCIDENT UPON BARIUM SURFACES
J. R. Hiskes and A. M. Karo 1989 8 p Presented at the 5th International Symposium on the Production and Neutralization of Negative Ions and Beams, Upton, NY, 30 Oct. - 3 Nov. 1989
(Contract W-7405-eng-48; AF-AFOSR-0039-89)
(DE90-005549; UCRL-102087; CONF-891055-3) Avail: NTIS HC A02/MF A01

The generation of vibrationally excited molecules by electron excitation collisions and the subsequent generation of negative ions by dissociative attachment to these molecules has become a standard model for volume source operation. These processes have been supplemented recently by the demonstration of atom-surface recombination to form vibrationally excited molecules, and enhanced negative ion formation by protons incident upon barium electrodes. In this paper we consider the additional processes of molecular vibrational excitation generated by recombination of molecular ions on the electrode surfaces, and negative ion formation by vibrationally excited molecules rebounding from low work-function electrodes. DOE

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

N90-17424*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
RESULTS OF AN ATTEMPT TO MEASURE INCREASED RATES OF THE REACTION D-2 + D-2 YIELDS He-3 + n IN A NONELECTROCHEMICAL COLD FUSION EXPERIMENT
Gustave C. Fralick, Arthur J. Decker, and James W. Blue Dec. 1989 24 p
(NASA-TM-102430; E-5198; NAS 1.15:102430) Avail: NTIS HC A03/MF A01 CSCL 20H

An experiment was performed to look for evidence of deuterium

fusion in palladium. The experiment, which involved introducing deuterium into the palladium filter of a hydrogen purifier, was designed to detect neutrons produced in the reaction D-2 + D-2 yields He-3 + n as well as heat production. The neutron counts for deuterium did not differ significantly from background or from the counts for a hydrogen control. Heat production was detected when deuterium, but not hydrogen, was pumped from the purifier.
Author

74 OPTICS

Includes light phenomena; and optical devices.
For lasers see *36 Lasers and Masers.*

N90-17425# ERG Systems, Inc., Saint James, NY.
FULL SURFACE INTERFEROMETRIC TESTING OF GRAZING INCIDENCE MIRRORS
John L. Remo Sep. 1989 3 p Sponsored by Strategic Defense Initiative Organization
(Contract N00014-89-C-0199)
(AD-A213590) Avail: NTIS HC A01/MF A01 CSCL 20/6

This research is in the initial stage of testing, designing, and constructing a scanning shearing interferometer breadboard for measuring the full surface figure and macroroughness of cylindrical and toroidal aspheric grazing incidence mirrors. This approach using normal incidence subaperture shearing interferometry combines high measuring accuracy and measuring speed with iow sensitivity to environmental disturbances. Past approaches used: full aperture interferometry at grazing incidence, which results in very small beam cross section and low accuracy and pointwise interferometry with a long trace profiler, which is too slow and too sensitive to environmental disturbances for full surface scanning. To achieve this goal a cylindrical beam shearing interferometer is used to measure the mirror figure over a series of extended, overlapping subapertures, then the full surface figure is synthesized in software. GRA

N90-17426# Colorado State Univ., Fort Collins. Dept. of Physics.
MAGNETOSTATIC WAVE DEVICE CHARACTERIZATION BY BRILLOUIN LIGHT SCATTERING Final Report, Feb. 1985 - Aug. 1988
Carl E. Patton and Gopalan Srinivasan Feb. 1989 12 p
(Contract F19628-85-K-0002; AF Proj. 2305)
(AD-A213798; RADC-TR-88-300) Avail: NTIS HC A02/MF A01 CSCL 20/6

This final report summarizes the important results of the Brillouin light scattering investigations of magnetic excitations in magnetostatic wave (MSW) devices which were carried out under the RADC contract. The key accomplishments were the observation and characterization of surface waves, forward volume waves, backward volume waves, parametric spin waves, and a new type of evanescent surface wave in yttrium iron garnet film MSW devices. The propagation characteristics for surface wave in Fe, Co-Cr, and Ni-Fe films were also examined, in order to investigate the possible use of such films in MSW devices. Details on technical publications and participating personnel during this contract period are also provided. GRA

N90-17427# Rockwell International Corp., Thousand Oaks, CA. Science Center.
STUDIES OF OPTICAL MATRIX MULTIPLICATION AND RECONFIGURABLE OPTICAL INTERCONNECT CONCEPTS Final Report, 1 Nov. 1986 - 30 Apr. 1989
Pochi Yeh Jul. 1989 151 p
(Contract F49620-87-C-0015)
(AD-A214645; SC5502.FR; AFOSR-89-1290TR) Avail: NTIS HC A08/MF A01 CSCL 09/5

Unique optical computing concepts which use nonlinear optical phenomena to perform matrix multiplication and to provide reconfigurable optical interconnection was studied. The use of real time holography in nonlinear media such as photorefractive crystals for optical computing is examined. By incorporating the parallel nature of optics in nonlinear media, it is possible to perform parallel matrix multiplication using four-wave mixing. In addition, the dynamic holography in nonlinear optical media provides a natural candidate for the configurable interconnection. The general problem in this program is to generate and investigate new concepts which use these nonlinear optical phenomena for optical computing. Specifically, this program investigates experimentally and theoretically the multiplication of matrices using optical four-wave mixing in nonlinear media, and the possibility of using such matrix multiplication and wave mixing for reconfigurable interconnection. GRA

N90-17428# Massachusetts Inst. of Tech., Lexington. Lincoln Lab.
SPECKLE IMAGING THROUGH THE ATMOSPHERE
Willet Beavers, Dan E. Dudgeon, James W. Beletic, and Mark T. Lane 5 Jul. 1989 23 p Submitted for publication
(Contract F19628-85-C-0002)
(AD-A214652; JA-6326; ESD-TR-89-243) Avail: NTIS HC A03/MF A01 CSCL 17/5

The atmosphere is the limiting factor in high-resolution ground-based optical telescope observations of objects in space. New speckle-imaging techniques allow astronomers to overcome atmospheric distortion and achieve the goal of diffraction-limited groundbased telescope performance. Studies and experiments at Lincoln Laboratory utilize speckle imaging for observation of near-earth satellites. Thousands of separate exposures, each 2 to 5 ms in duration, are collected within a few seconds. A computationally intensive algorithm is then used to reconstruct a single diffraction-limited image from the collection of separate exposures. The image-reconstruction process effectively removes the distortion imposed by the atmosphere. Photon noise, which limits the quality of image reconstruction, must be properly compensated by the actual detector calibration. GRA

N90-17429# University of Southern California, Los Angeles. Dept. of Electrical Engineering.
ADAPTIVE MULTIPLE-BAND CFAR (CONSTANT-FALSE-ALARM-RATE) DETECTION OF AN OPTICAL PATTERN WITH UNKNOWN SPECTRAL DISTRIBUTION Final Technical Report, Jan. - Nov. 1988
Robert Gagliardi and Irving S. Reed Jun. 1989 34 p
(Contract F19628-86-K-0008; AF Proj. 2305)
(AD-A214754; RADC-TR-89-77) Avail: NTIS HC A03/MF A01 CSCL 12/9

A generalized constant false-alarm rate (CFAR) algorithm is developed for detecting the presence of an optical signal of non-zero intensity in J signal-plus-noise bands or channels. For many applications this new algorithm is more flexible and practical than previous ones. If J=1, the resulting test reduces to the standard normalized matched filter test for finding a signal in clutter of unknown and varying intensity. Both theoretical and computer simulation results show that the SNR improvement gain of this new algorithm using multiple band scenes over the single scene of maximum SNR is always greater than one and in some cases it can be substantial. The data base used to simulate this new adaptive CFAR test are actual LANDSAT image scenes. The present results for optical detection are extendable to radar target detection and to other related detection problems. GRA

N90-17430# Georgia Inst. of Tech., Atlanta.
MONOCHROMATOR CONFIGURATIONS FOR WAVELENGTH DIVISION MULTIPLEXING Final Report, Mar. 1987 - Mar. 1988
Russell A. Chipman and Thomas Burleson Oct. 1989 111 p
(Contract F30602-81-C-0185)
(AD-A214833; RADC-TR-89-196) Avail: NTIS HC A06/MF A01 CSCL 20/6

The purpose of this work was to investigate the application of modified Czerny-Turner spectrographic optical systems to high channel density wavelength division multiplexing. A breadboard test system was constructed using off-the-shelf components and system performance was measured and evaluated. The results

found using the breadboard system will be used to further develop measurement techniques for WDM systems and also to increase the performance of other high density systems. In parallel with the breadboard fabrication/evaluation, a series of lenses to increase system performance were designed. GRA

N90-17431# Optron Systems, Inc., Bedford, MA.
ELECTRON-BEAM PHASE-ONLY SPATIAL LIGHT MODULATOR FOR MATCHED FILTERING Final Technical Report, Aug. 1987 - Sep. 1988
Cardinal Warde and Robert L. Hillman Aug. 1989 31 p
(Contract F19628-86-C-0186; AF Proj. 2305)
(AD-A215026; RADC-TR-89-102) Avail: NTIS HC A03/MF A01 CSCL 17/5

A vacuum demountable electron beam addressed LiNbO3 crystal spatial light modulator was designed, fabricated, and tested. The device works in a phase-only mode, capable of being placed in the filter plane of a coherent optical correlator. The measured performance parameters were: spatial resolution-2 lines/mm; contrast ratio - 20:1; phase dynamic range 5 pi, and storage time - 5 minutes. A theoretical resolution of 10 lines/mm would be possible with an improved electron gun assembly. GRA

N90-17432# Aerodyne Research, Inc., Billerica, MA.
AGGREGATE FILTER Final Technical Report, Jan. - Jul. 1988
Roger Scott Putnam Mar. 1989 37 p
(Contract F19628-88-M-0004; AF Proj. 2305)
(AD-A215029; ARI-RR-662; RADC-TR-88-317) Avail: NTIS HC A03/MF A01 CSCL 20/6

Optical pattern recognition is extremely effective for well defined targets, and naturally discriminates against small changes in the target shape. Attempts to reduce the discriminatory power of the Fourier plane filter to permit some adjustments such as size or perspective changes while still identifying the overall shape have been generally unsuccessful. These attempts usually involve reducing the information content in the detection filter through various forms of low pass filtering such as circular or radial smearing. Our research is directed at increasing the information content to obtain optical pattern recognition of distorted or rotated or multiple targets. This is accomplished by combining multiple Fourier plane filters which are non-overlapping in the Fourier plane and therefore do not interfere with each other. This system fills the Fourier plane with useful information for detecting multiple targets. It is most effective when the targets are most dissimilar, therefore having the least overlap in the Fourier plane . This is opposite from past approaches aimed at smearing together several similar targets. GRA

N90-17433# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
GABOR TRANSFORMS FOR FORWARD LOOKING INFRARED IMAGE SEGMENTATION M.S. Thesis
Kevin W. Ayer Dec. 1989 234 p
(AD-A215046; AFIT/GEO/ENG/89D-1) Avail: NTIS HC A11/MF A02 CSCL 20/6

The difficult task of segmenting targets in clutt ered FLIR images is investigated. This research initiated investigation into classifying the segmented targets based on the same method used for segmentation. The primary means for segmenting and classifying targets was the biologically motivated use of Gabor transforms. This research successfully produced a complete segmentation system based on correlations between FLIR images and non-self similar or modified self similar Gabor functions. Initial investigation into methods for recognition of targets and their detailed sub-structures was accomplished using self similar and modified self similar Gabor transforms correlation coefficients stacked in jets. Nearest neighbor recognition using the jets method produced accuracy of 0.622. Nearest neighbor recognition of targets using jets for input to a k-nearest neighbor network produced final accuracy of 0.6214 (for calculations based on seven nearest neighbors). An optical Gabor transform design is introduced to implement the computation of the Gabor coefficients. GRA

N90-17434# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
ENHANCED TRACKING OF BALLISTIC TARGETS USING FORWARD LOOKING INFRARED MEASUREMENTS WITH ACTIVE TARGET ILLUMINATION M.S. Thesis
Claude W. Eden Dec. 1989 236 p
(AD-A215422; AFIT/GE/ENG/89D-11) Avail: NTIS HC A11/MF A02 CSCL 17/5

This work has continued the development of an algorithm for tracking airborne targets using measurements from an array of infrared detector elements. Until now, the research has only been concerned with passively acquired measurements. This thesis effort expands this by considering the addition of actively acquired measurements, i.e., measurements of laser light reflected from the target. GRA

N90-17435# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
HYBRID OPTICAL/DIGITAL ARCHITECTURE FOR DISTORTION INVARIANT PATTERN RECOGNITION M.S. Thesis
John D. Cline Dec. 1989 292 p
(AD-A215628; AFIT/GEO/ENG/89D-2) Avail: NTIS HC A13/MF A01 CSCL 09/5

This research investigated optical techniques for pattern recognition. An optical joint transform correlator was implemented using a magneto-optic spatial light modulator, and a charge coupled device (CCD) camera and frame grabber under personal computer (PC) control. A hybrid optical/digital architecture that could potentially perform position, scale, and rotation invariant pattern recognition using a computer generated hologram (CGH) was also implemented. The joint transform correlator was tested using forward looking infrared (FLIR) imagery containing tactical targets, and gave very good results. New techniques for binarizing the FLIR inputs and the fringe pattern of the joint transform were discovered. The input binarization used both scene average and a localized energy normalization technique for binarization. This resulted in reduced scene background, while retaining target detail. The fringe binarization technique subtracted the Fourier transform of the scene from the joint transform, and binarized on the average difference. This new technique was a significant improvement over recent published designs. GRA

N90-17436# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
INFRARED TARGET DETECTION: SIGNAL AND NOISE SENSITIVITY ANALYSIS M.S. Thesis
Christopher W. Keefer Dec. 1989 78 p
(AD-A215707; AFIT/GEO/ENP/89D-2) Avail: NTIS HC A05/MF A01 CSCL 17/5

The effect was determined of the statistical properties of the signal and the noise on an infrared system's detection performance. Noise sources identified and characterized include Johnson noise, shot noise, generation-recombination noise, and photon noise. The signal was characterized as either constant or fluctuating. A computer model was used to evaluate system detection performance for various combinations of signal type and noise distribution. Results are presented in terms of probability of detection versus signal to noise ratio. Analysis of the results suggest that an IR system's detection performance cannot be measured in terms of signal to noise ratio alone. The system designer needs to take into account the statistical properties of the signal and the noise to accurately predict system performance with an IR detection model. GRA

N90-17437# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
BROADBAND INCOHERENT IMAGING USING MULTIPLE APERTURE OPTICS M.S. Thesis
Konrad S. Gruca Dec. 1989 102 p
(AD-A215708; AFIT/GEO/ENP/89D-3) Avail: NTIS HC A06/MF A01 CSCL 17/5

The theoretical resolution of a multiple mirror telescope can

be studied through its Modulation Transfer Function (MTF). Using the figure of merit that the mirrors be moved apart in a manner that would maximize the spatial frequency at which the first zero appears in the MTF, the use was studied of MTF information from multiple wavelengths to delay the appearance of an interior zero in the overall MTF. This would allow the mirrors to be moved further apart and thereby increase the frequency at which the first zero appears in the MTF, increasing the resolving capability of the system. Symmetrical configurations from three to six mirrors were studied. Each configuration was initially manually optimized at three microns, then the system was studied at a three to five micron range to see if the MTF information from other wavelengths would delay the appearance of an interior zero in the overall system MTF, thus allowing an increase in the distance between mirrors. An optimization routine was also employed to see if there were other, nonsymmetrical, mirror configurations that could possibly yield a better theoretical resolution than their symmetrical counterparts. GRA

N90-17438# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
STARING FOCAL PLANE ARRAY SYSTEM MODELING M.S. Thesis
John G. Murphy Dec. 1989 78 p
(AD-A215712; AFIT/GEO/ENP/89D-3) Avail: NTIS HC A05/MF A01 CSCL 17/5

The problems are analyzed of modeling staring focal plane array systems. Two problem areas are highlighted; the difficulty in modeling the operator interface and the inadequate characterization of focal plane array noise sources. The effects of aliasing, response nonuniformity, and the 2-D nature of the spatial and temporal noise require more sophisticated handling than found in present models. Three staring array models were used to predict the Minimum Resolvable Temperature Difference (MRTD) for three Platinum Silicide staring array cameras. The predictions were then compared, analyzed, and suggestions for model improvement were made. GRA

N90-17439# Max-Planck-Inst. fuer Physik und Astrophysik, Garching (Germany, F.R.). Inst. fuer Extraterrestrische Physik.
TRANSMISSION MICRO-GRIDS FOR SHIFT ANALYSIS OF X RAY FREQUENCIES Thesis - Tech. Univ. Munich [DIE EIGENSCHAFTEN VON TRANSMISSIONSGITTERN FUER DEN WEICHEN ROENTGENBEREICH]
Hans Lochbihler Aug. 1989 85 p In GERMAN
(MPE-Rept-216; ISSN-0178-0719; ETN-90-96180) Copyright Avail: NTIS HC A05/MF A01

Extremely fine grid diffraction gratings are described. These gratings are used in shift analysis of x ray frequency radiation. Test results of the grid are presented. The experimental methodology is described. The experimental method is concluded easy to follow and the quality of the results obtained shown as good. ESA

N90-17440# Tennessee Univ., Knoxville. Dept. of Electrical and Computer Engineering.
A VISION SYSTEM FOR ROBOTIC INSPECTION AND MANIPULATION
Mohan M. Trivedi, ChuXin Chen, and Suresh Marapane Mar. 1989 12 p Presented at the SPIE/SPSE Symposium on Electronic Imaging: Advanced Devices and Systems, Los Angeles, CA, 15-20 Jan. 1989
(Contract DE-FG02-86NE-37968)
(DE90-005412; DOE/NE-37968/11; CONF-890143-3) Avail: NTIS HC A03/MF A01

Advanced robotic systems should be able to perform a variety of tasks in complex, unstructured environments with increased level of autonomy. Robots provide the physical link between intelligence and action. Structurally, a robot can be considered as having three modules. These include: (1) mechanical assemblies, such as robot arm, end effectors, and mobility platforms, (2) sensors, for sensing the work environment of a robot, and (3) the Perception, Planning and Control unit, which is utilized for interpreting the sensory inputs and for planning and controlling the actions of the robot. Most of the robotic systems currently employed in the industry require a highly structured environment for the robot to operate. This requirement can be relaxed if the robot is endowed with an array of external sensors to sense its environment. The sensor-driven operation is critical for making robots more versatile and flexible to use. Advanced robotic systems which are capable of utilizing sensor modalities such as vision, range, force, and touch can be employed in a variety of application domains. Of these, vision is recognized to be a very important sensory modality. It offers rich sensory data for accurate and detailed interpretation of the composition of a robot's work environment. Object recognition, determination of their locations in the 3-dimensional workspace, inspection of their status are all important tasks where vision derived information can be effectively utilized. DOE

N90-17087*# Maryland Univ., College Park. Inst. for Physical Science and Technology.
CRITICAL FLUID LIGHT SCATTERING
Robert W. Gammon *In* NASA, Lewis Research Center, NASA Laser Light Scattering Advanced Technology Development Workshop, 1988 Aug. 1989 p 25-44 Previously announced in IAA as A88-33009 (For primary document see N90-17085 09-35)
(Grant NAG3-727)
Avail: NTIS HC A14/MF A02 CSCL 20A

N90-17090*# State Univ. of New York, Stony Brook. Dept. of Electrical Engineering.
DESIGN OF FIBER OPTIC PROBES FOR LASER LIGHT SCATTERING
Harbans S. Dhadwal and Benjamin Chu *In* NASA, Lewis Research Center, NASA Laser Light Scattering Advanced Technology Development Workshop, 1988 Aug. 1989 p 81-98 (For primary document see N90-17085 09-35)
Avail: NTIS HC A14/MF A02 CSCL 20A

N90-17093*# Brookhaven Instruments Corp., Holtsville, NY.
ADVANCED INSTRUMENTATION FOR QELS EXPERIMENTS
Walther Tscharnuter, Bruce Weiner, and John Thomas *In* NASA, Lewis Research Center, NASA Laser Light Scattering Advanced Technology Development Workshop, 1988 Aug. 1989 p 135-139 (For primary document see N90-17085 09-35)
Avail: NTIS HC A14/MF A02 CSCL 20A

N90-17094*# Coulter Electronics, Inc., Amherst, MA. Langley Ford Instruments.
ENHANCED RESOLUTION PARTICLE SIZE DISTRIBUTIONS BY MULTIPLE ANGLE PHOTON CORRELATION SPECTROSCOPY
Steven E. Bott *In* NASA, Lewis Research Center, NASA Laser Light Scattering Advanced Technology Development Workshop, 1988 Aug. 1989 p 141-152 (For primary document see N90-17085 09-35)
Avail: NTIS HC A14/MF A02 CSCL 20A

N90-17095*# Particle Sizing Systems, Inc., Santa Barbara, CA.
ONLINE SUBMICRON PARTICLE SIZING BY DYNAMIC LIGHT SCATTERING USING AUTODILUTION
David F. Nicoli and V. B. Elings *In* NASA, Lewis Research Center, NASA Laser Light Scattering Advanced Technology Development Workshop, 1988 Aug. 1989 p 153-164 (For primary document see N90-17085 09-35)
Avail: NTIS HC A14/MF A02 CSCL 20A

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N90-17441# International Centre for Theoretical Physics, Trieste (Italy).
POSSIBILITY OF LOW-FREQUENCY ELECTRON WAVE IN A BEAM-PLASMA SYSTEM
M. Y. El-Ashry and I. Talukdar (Indian Inst. of Tech., New Delhi.) Jun. 1989 8 p Submitted for publication
(DE90-601021; IC-89/138) Avail: NTIS (US Sales Only) HC A02/MF A01

Attention was drawn to the possibility of existence and excitation of an electron low-frequency wave by electron beam in electron plasma. The instability analysis was done to show that a new spectrum of low frequency electromagnetic waves are excited by the beam. The growth rate of excitation is also found. DOE

N90-17442# Kyoto Univ., Uji (Japan). Plasma Physics Lab.
DENSITY CLAMPING PHENOMENA IN ELECTRON CYCLOTRON RESONANCE HEATED PLASMAS ON HELIOTRON E
H. Zushi, N. Noda, T. Mizuuchi, M. Sato, S. Sudo, K. Kondo, H. Kaneko, H. Matsuura, M. Tohda, and O. Motojima et al Aug. 1988 46 p
(DE90-719523; PPLK-R-27) Avail: NTIS (US Sales Only) HC A03/MF A01

Particle transport and related phenomena are investigated in currentless electron cyclotron resonance heated plasmas. It is observed that during the initial phase the density stops rising and then starts to decay, in spite of continuous gas puffing. The delay time between the breakdown time and the time at which the density starts to decay depends inversely on RF power. The density profile changes drastically, becoming flat or hollow at this time. This density profile change becomes more significant as the RF power is increased. In order to sustain the density at some level the external particle source should be increased with increasing RF power. Here it is found that the particle confinement time decreases with increasing power. The substantial increase in the particle outflux from the main plasma causes the scrape-off plasma to have a steep gradient. As a result, the amplitudes of density and magnetic fluctuations are enhanced with increasing RF power. When the cyclotron resonance layer is shifted outside the half radius, it is found that the density profile changes from hollow to centrally peaked. This result shows that the density profile is a function of the power deposition profile. It is also shown that the behavior of impurity ions (injected by the laser blow-off technique) is similar to that of the bulk particles. DOE

N90-17443# Kyoto Univ., Uji (Japan). Plasma Physics Lab.
STUDY ON EDGE PLASMA PHYSICS AND PARTICLE CONTROL IN THE HELIOTRON E DEVICE
T. Mizuuchi, T. Obiki, N. Noda, H. Matsuura, H. Minagawa, S. Kato, H. Oyama, H. Toyoda (Nagoya Univ., Japan), K. Kondo, and K. Akaishi et al Jul. 1988 43 p
(DE90-719524; PPLK-R-26) Avail: NTIS (US Sales Only) HC A03/MF A01

The edge plasma physics and the particle controls under the intrinsic magnetic limiter configuration of a helical system were studied with the Heliotron E device, where currentless plasmas of T(sub e) is less than or equal to 1 to 2 keV, T(sub i) is less than or equal to 1 keV and n-bar(sub e) is less than or equal to 2 x 10(exp 20)/cu m are produced by a combination of ECRH, NBI, and/or ICRH. It is indicated that the separatrix region of the heliotron device is able to act as a divertor magnetic field. According to calculations of the magnetic field line in the edge region, the separatrix region has some different characteristics from the scrape-off layer in tokamak devices; the existence of a fine structure in the separatrix region and asymmetry of the region in toroidal and poloidal directions are observed. A localized pattern of the heat load on the first wall is experimentally observed. This agrees with the heat-load profile expected from the magnetic configuration and the distribution of the plasma in the edge region. A carbonization of the first wall is successfully applied to the Heliotron E device for reduction of metallic impurity contents. The heat load at the divertor trace decreases and that on the other part of the first wall increased in the high recycling conditions after the carbonization. DOE

N90-17444# Kyoto Univ., Uji (Japan). Plasma Physics Lab.
PHASE PROPERTIES OF THE RAPID COOLED PALLADIUM-SILICON ALLOY IN THE CONCENTRATION RANGE 40 TO 58 AT. PERCENT Si
K. Tsumori and H. Akimune Oct. 1988 36 p
(DE90-719525; PPLK-R-30) Avail: NTIS (US Sales Only) HC A03/MF A01

The phase diagram for Pd-Si system is reinvestigated by thermal analysis with a method taking the second derivative of time dependent temperature and by metallographic measurement, where the cooling rate is about 140 C/min. The second derivative offers a sensitive and accurate means for the thermal analysis with aid of microcomputer. The intermetallic compound PdSi has no temperature peak in the phase diagram. In the Si concentration higher than 50 at. percent, the alloy appears to be the eutectic for the constitutions of PdSi and Si, and the eutectic point locates at 895 C and 50 at. percent, the alloy appears to be the eutectic for the constitutions of Pd2Si and PdSi, and the eutectic point locates at 886 C and about 48.5 at. percent of Si. The phase properties appear to be largely affected by the phase stability of PdSi in company with the departure from thermal equilibrium in the thermal analysis. The addition of Ag impurity of small amount collapses PdSi phase and the alloy appears to be the eutectic for the constitutions of Pd2Si and Si in the concentration range from Pd2Si to Si. DOE

N90-17445# General Atomic Co., San Diego, CA.
ELECTRON ASSISTED GLOW DISCHARGES FOR CONDITIONING FUSION TOKAMAK DEVICES
K. M. Schaubel and G. L. Jackson Aug. 1989 23 p Presented at the 36th American Vacuum Society National Vacuum Symposium, Boston, MA, 23-27 Oct. 1989
(Contract DE-AC03-89ER-51114)
(DE90-004104; GA-A-19809; CONF-891093-18) Avail: NTIS HC A03/MF A01

Glow discharge conditioning of tokamaks with graphite plasma-facing surfaces has been used to reduce impurities and obtain density control of the plasma discharge. However, a major operational disadvantage of glow conditioning is the high pressure required to initiate the glow discharge, e.g., approx. 70 mTorr for helium in DIII-D, which requires isolating auxiliary components that can not tolerate the high pressure. An electron-gun assisted glow discharge can lower breakdown pressure, possibly eliminating the necessity of isolating these auxiliary systems during glow discharge conditioning and allowing glow discharge operation at lower pressures. DOE

N90-17446# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering.
A DESIGN PROCEDURE FOR A SLOTTED WAVEGUIDE WITH PROBE-FED SLOTS RADIATING INTO PLASMA
Jeffrey A. Colborn Nov. 1989 25 p
(Contract DE-AC02-78ET-51013)
(DE90-004168; DOE/ET-51013/277; PFC/RR-89-17) Avail: NTIS HC A03/MF A01

A design procedure is developed for slotted-waveguide antennas with probe-fed slots. Radiation into a gyrotropic, plane-stratified medium is considered, nonzero waveguide wall thickness is assumed, and noncosinusoidal slot fields and arbitrary slot length up to about one free-space wavelength are allowed. External mutual coupling is taken into account by matching the tangential fields at the antenna surface. The particular case of longitudinal slots in the broad face of rectangular guide is analyzed. The motivation for this work is the design of such radiators for plasma heating and current-drive on thermonuclear fusion

experiments, but some of the analysis is applicable to the probeless slotted waveguide used for avionics and communications. DOE

N90-17447# Oak Ridge National Lab., TN.
A PRELIMINARY INVESTIGATION OF COLD FUSION BY ELECTROLYSIS OF HEAVY WATER
C. D. Scott, J. E. Mrochek, E. Newman, T. C. Scott, G. E. Michaels, and M. Petek Nov. 1989 31 p
(Contract DE-AC05-84OR-21400)
(DE90-004383; ORNL/TM-11322) Avail: NTIS HC A03/MF A01

Several tests have been made with electrolytic cells utilizing 0.1 to 0.2 N LiOD in D2O as the electrolyte and a palladium cathode surrounded by a wire-wound platinum anode operating at cathode current densities of 100 to 600 mA/sq cm. The cathodes were swaged to diameters of 2.8 or 5.5 mm with 8.0 to 8.5 cm of active length and then annealed in some tests. The electrolyte temperature was controlled and heat was removed by flowing water in a cooling jacket, and the cell was insulated. Cooling water and electrolyte temperatures were determined by thermocouples; neutron and gamma-ray spectra were measured; and the electrolyte was periodically analyzed for tritium. In one test, an internal wire coil of platinum coated with palladium black was used in a closed system to recombine the electrolytically generated D2 and O2 without release of any off-gas. The electrolyte was periodically sampled and electrolyte of the nominal concentration was added to replace the volume withdrawn; makeup D2O was also added, when required, in those experiments which did not include a recombiner. Neutron and gamma-ray spectra were recorded on magnetic media; temperatures, coolant flow rate, and voltages were recorded and, in the last two experiments, acquired by a computer data acquisition system. Tests up to 1000 h in duration were made, and in some experiments excess power was detected for periods of many hours, usually in the range of 5 to 15 percent. However, during one 12-h period, excess power of up to 50 percent was observed. On three separate occasions, the neutron count rate exceeded the background by three standard deviations; in addition, an apparent transient increase of tritium in the electrolyte by at least a factor of 25 occurred during one test. DOE

N90-17448# Stanford Univ., CA. High Temperature Gasdynamics Lab.
ADVANCED DIAGNOSTICS FOR REACTING FLOWS Annual Report, 1 Oct. 1988 - 30 Sep. 1989
R. K. Hanson 12 Oct. 1989 36 p
(Grant AF-AFOSR-0067-89; AF Proj. 2308)
(AD-A214795; AFOSR-89-1409TR) Avail: NTIS HC A03/MF A01 CSCL 20/9

Progress is reported for an interdisciplinary program aimed at establishing advanced optical diagnostic techniques applicable to combustion and plasma flows. The primary effort is on digital flowfield imaging techniques, which offer significant potential for a wide range of spatially resolved 2-D and 3-D measurements. The imaging is accomplished by recording light scattered from a planar laser illuminated region using a modern solid state camera. The scattering process is generally laser induced fluorescence, though Mie, Rayleigh and Raman scattering may also be used. Activities reported include: (1) image processing of PLIF data; (2) PLIF imaging in nonequilibrium shock tube flows; (3) temperature and velocity imaging in supersonic flows; (4) concept for simultaneous measurement of multiple parameters; (5) digital camera for high speed imaging; (6) plasma diagnostics; (7) laser photolysis shock tube; and (8) CW UV laser absorption diagnostics. GRA

N90-17449# Gordon Research Conferences, Inc., Kingston, RI.
THE 10TH GORDON RESEARCH CONFERENCE ON PLASMA CHEMISTRY Final Report, 1 Jul. 1988 - 30 Jun. 1989
Alan Garscadden Oct. 1989 27 p Conference held in Tilton, NH, 15-19 Aug. 1988
(Grant AF-AFOSR-0208-88; AF Proj. 2301)
(AD-A215161; AFOSR-89-1502TR) Avail: NTIS HC A03/MF A01 CSCL 20/9

The 1988 Gordon Research Conference on Plasma Chemistry was divided into nine sessions. Eight had two or three invited talks and two or three discussion papers with the total never exceeding five. The ninth session was a poster session which had 45 presentations. Two sessions dealt with the latest findings in low pressure, non-equilibrium plasma chemistry, covering the topics of plasmas in device technology, and plasma enhanced processing including diamond thin films and microwave plasma etching. One high pressure, thermal plasma session covered plasma processing for metallurgical applications and surface-plasma interactions. Six joint sessions included sessions on future plasma chemistry, nucleation and growth, plasma modeling, one each on diagnostics and new techniques in plasma synthesis/processing and the poster session. GRA

N90-17450# Naval Research Lab., Washington, DC. Radiation Hydrodynamics Branch.
SCALING Z-PINCH PLASMAS WITH ATOMIC NUMBER FOR A GIVEN K-SHELL EMISSION
Kenneth G. Whitney, J. P. Apruzese, J. W. Thornhill, and J. Davis 17 Nov. 1989 34 p
(AD-A215703; NRL-MR-6579) Avail: NTIS HC A03/MF A01 CSCL 20/9

A major goal in using z-pinch plasmas as high brightness laboratory sources of x rays is to increase the radiation emission above about 1keV through the use of moderate atomic number (Z = 10 to 36) materials. Two kinds of configuration, single wires and wire arrays or foils, have been investigated in the past. In both cases, it has been observed that optimal x ray emission decreases on a given machine as the atomic number of the z-pitch material is increased. A description is presented of how a previously developed model can be modified and extended to provide predictions of how machine and diode designs must be scaled in order to maintain a given K-shell x ray emission as the plasma atomic number increases in z-pinch array implosions. Simple scaling arguments are developed to show how specification of a desired total K-shell emission can be used to determine the parameters of an imploding array z-pinch plasma as a function of the atomic number of the pinch. The model used ignores all hydrodynamic details of the z-pinch implosion and thermalization processes and assumes that all the plasma mass is imploded and thermalized. The pinch is also assumed to be driven by a prescribed linearly rising current. Scaling laws that are derived from these assumptions, in effect, contain phenomenological scaling parameters whose values will need to be more accurately determined by more detailed theoretical calculations and/or by z-pinch experiments on a variety of different machines. GRA

N90-17451# National Aerospace Lab., Tokyo (Japan).
SPECTRAL CHARACTERISTICS OF ARC-HEATED LOW DENSITY PLASMA FLOWS (IV) AIR AND N2-CO2 MIXTURE PLASMAS
Y. Watanabe and N. Hirabayashi Feb. 1989 15 p In JAPANESE; ENGLISH summary
(NAL-TR-1012; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

Spectra excited in air and N2-CO2 mixture plasma flows were recorded for the analysis of radiation characteristics of the flows in an arc-heated low density wind tunnel. The air plasma in the plenum chamber showed the Schumann-Runge band system of oxygen, intensity distributions of which corresponded to the heat-balance temperature. NO+O recombination continum was the main emission source of the low density test section flow. Spectral features convenient for temperature determination were not found. Stong CN violet emission was observed in the N2-CO2 mixture plasma in the plenum chamber and was used to determine the stagnation temperatures. The difference between spectroscopic and heat balance temperatures was rather large, which suggests the existence of chemical nonequilibrium, relaxation or absorption effects. Author

N90-17452# Lawrence Livermore National Lab., CA. High Temperature Physics Div.
EQUATION OF STATE OF PARTIALLY-IONIZED DENSE PLASMAS
F. J. Rogers 28 Sep. 1989 34 p Presented at the Short Course on High-Pressure Equations of State: Theory and Applications, Varenna, Italy, 25 Jul. - 4 Aug. 1989
(Contract W-7405-eng-48)
(DE90-005246; UCRL-102242; CONF-8907152-2) Avail: NTIS HC A03/MF A01

Methods are described for calculating the equation of state of partially-ionized dense plasmas. The term dense plasma is used rather than strongly coupled plasma, since it is possible that at plasma conditions such that only a few levels can be observed spectroscopically the plasma coupling parameters are not large. Due mainly to their importance in theoretical astrophysics, the properties of partially ionized plasmas were of interest for a long while. More recently, this interest has intensified due to the development of methods for producing partially ionized plasmas in the laboratory. This has opened up large programs of experimental investigation and of practical application. Detailed statistical mechanical methods are considered that explicitly treat the distribution over ionic species and their energy level structure. These detailed approaches are generally characterized as being in the chemical picture when a free energy expression is minimized or in the physical picture when the starting point is the grand canonical ensemble. DOE

N90-17453# Lawrence Livermore National Lab., CA.
TWO-DIMENSIONAL CALCULATION OF SEQUENTIAL ELECTRON LAYER FORMATION BY CROSSED MICROWAVE BEAMS IN AIR AT LOW PRESSURE
D. J. Mayhall, J. H. Yee, G. E. Sieger, and R. A. Alvarez 27 Nov. 1989 12 p Presented at the 9th International Workshop on Laser Interaction and Related Plasma Phenomena, Monterey, CA, 6-10 Nov. 1989
(Contract W-7405-eng-48)
(DE90-005254; UCRL-101452; CONF-891136-2) Avail: NTIS HC A03/MF A01

Laboratory chamber experiments in low-pressure (0.1 to 10 Torr) air with long-pulse (150 to 600 ns), 2.856 GHz crossed microwave beams, created by reflection of an incident beam from a metal plate inclined at 45 degrees, have shown that multiple, luminous electron density layers form toward the source of the incident beam. Previous two-dimensional calculations of microwave air breakdown in a rectangular waveguide with full resolution of each cycle of the driving electric field required Cray 1 computation times of about 0.5 hr/ns for runs of up to 20 ns of simulation time. To simulate chamber experiments with pulses of 150 to 600 ns duration, computation times with full-cycle resolution must be expected to be 75 to 300 hours per run. Because there are prohibitive run times, a code, which follows only the pulse envelope, was developed to reduce computation time. This envelope approximation is an extension of the one-dimensional technique for atmospheric microwave propagation reported previously. DOE

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N90-17454*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
METHOD OF FORMING LOW COST, FORMABLE HIGH T(SUBc) SUPERCONDUCTING WIRE Patent Application
James L. Smialek, inventor (to NASA) 28 Dec. 1989 9 p Sponsored by NASA
(NASA-Case-LEW-14676-2; US-Patent-Appl-SN-458467; NAS 1.71:LEW-14676-2) Avail: NTIS HC A02/MF A01 CSCL 20L

A ceramic superconductivity part, such as a wire, is produced through the partial oxidation of a specially formulated copper alloy in a core. The alloys contains low level of quantities of rare earth and alkaline earth dopant elements. Upon oxidation at high temperatures, and superconducting oxide phases are formed as a thin film. NASA

N90-17455*# National Aeronautics and Space Administration. Pasadena Office, CA.
FABRICATION OF NANOMETER SINGLE CRYSTAL METALLIC CoSi2 STRUCTURES ON Si Patent Application
Simon K. W. Nieh, inventor (to NASA), True-Lon Lin, inventor (to NASA), and Robert W. Fathauer, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 10 Aug. 1989 12 p
(Contract NAS7-918)
(NASA-Case-NPO-17736-1-CU; NAS 1.71:NPO-17736-1-CU; US-Patent-Appl-SN-392166) Avail: NTIS HC A03/MF A01 CSCL 20L

Amorphous Co:Si (1:2 ratio) films are electron gun-evaporated on clean Si(111) substrates, such as in a molecular beam epitaxy system. These layers are then crystallized selectively with a focused electron beam to form very small crystalline CoSi2 regions in an amorphous matrix. Finally, the amorphous regions are etched away selectively using plasma or chemical techniques. NASA

N90-17456*# National Aeronautics and Space Administration. Pasadena Office, CA.
EDGE GEOMETRY SUPERCONDUCTING TUNNEL JUNCTIONS UTILIZING AN NbN/MgO/NbN THIN FILM STRUCTURE Patent Application
Brian D. Hunt, inventor (to NASA) and Henry G. LeDuc, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 1 Aug. 1989 14 p
(Contract NAS7-918)
(NASA-Case-NPO-17812-1-CU; US-Patent-Appl-SN-387928; NAS 1.71:NPO-17812-1-CU) Avail: NTIS HC A03/MF A01 CSCL 20L

An edge defined geometry is used to produce very small area tunnel junctions in a structure with niobium nitride superconducting electrodes and a magnesium oxide tunnel barrier. The incorporation of an MgO tunnel barrier with two NbN electrodes results in improved current-voltage characteristics, and may lead to better junction noise characteristics. The NbN electrodes are preferably sputter-deposited, with the first NbN electrode deposited on an insulating substrate maintained at about 250 to 500 C for improved quality of the electrode. NASA

N90-17457# Argonne National Lab., IL. Materials and Components Technology Div.
DIFFUSION AND PROCESSING OF YBa2Cu3O(x)
K. C. Goretta, R. B. Poeppel, Donglu Shi, Nan Chen, S. J. Rothman, J. L. Routbort, and James P. Stoessel (TradeLink, Inc., Chicago, IL.) Oct. 1989 13 p Presented at the 1st International Ceramic Science and Technology Congress, Anaheim, CA, 31 Oct. - 3 Nov. 1989; sponsored by American Ceramic Society
(Contract W-31-109-eng-38)
(DE90-003569; CONF-8910120-6) Avail: NTIS HC A03/MF A01

Data were compiled on diffusion and diffusion-related properties of YBa2Cu3O(x). Results show that optimum superconducting properties are obtained when YBa2Cu3O(x) is processed in reduced oxygen pressures. In addition, because of competing effects of temperature and stoichiometry, post-sintering oxygen annealing is best conducted in stages over a range of temperatures, rather than at low temperature only. Recommendations for processing atmospheres, temperatures, and times are offered. DOE

N90-17458# Kyoto Univ., Uji (Japan). Plasma Physics Lab.
INVESTIGATION OF BOUNDARY FOR THE NEGATIVE ION EXTRACTION IN THE SHEET-PLASMA NEGATIVE ION SOURCE
Kouichi Jimbo and Joshin Uramoto (Nagoya Univ., Japan) Sep. 1988 24 p

(DE90-719532; PPLK-R-35) Avail: NTIS (US Sales Only) HC A03/MF A01

The negative ion current obtained in the sheet-plasma negative ion source increases when the stainless chamber is biased negative under the same plasma condition. At the same time the electron saturation current of the probe measurement also increases. In the classical treatment of sheath, the plasma-sheath equation was solved in the high order charge neutrality in plasmas, and the concept of presheath was introduced to satisfy the Bohm sheath criterion. The plasma space potential was calculated from the equality of ion and electron fluxes. However, the ion-acoustic instability is excited in that case. It is shown that the plasma-sheath equation has another solution and the plasma space potential is obtained self-consistently. The effect of negative currents are discussed at the same time. It is concluded that the plasma space potential relative to the ground level is the crucial parameter to extract negative ions effeciently from plasmas. DOE

N90-17459# Oak Ridge National Lab., TN.
GROWTH OF EPITAXICAL SiC LAYERS ONTO ON- AND OFF-AXIS 6H-SiC SUBSTRATES BY ION BEAM DEPOSITION
K. L. More, S. P. Withrow, T. E. Haynes, and R. A. Zuhr 1989 7 p Presented at the Materials Research Society Fall Meeting, Boston, MA, 27 Nov. - 2 Dec. 1989
(Contract DE-AC05-84OR-21400)
(DE90-004236; CONF-891119-39) Avail: NTIS HC A02/MF A01

Thin films of beta-SiC were grown epitaxically onto on-axis (0001) 6H alpha-SiC substrates using ion beam deposition. The ion beam deposition technique involves the direct deposition of alternating layers of (13)C(+) and (30)Si(+). The carbon and silicon ions were obtained from an ion implanter by decelerating mass analyzed ion beams to 40 eV. The SiC substrate was held at approx. 973 K. Thin films of alpha-SiC (a mixture of alpha-polytypes) were obtained following deposition onto off-axis approx. 2 deg 6H alpha-SiC. High resolution electron microscopy and Rutherford backscattering techniques were used to determine the structure and crystalline perfection of the resulting layers. DOE

N90-17460# Oak Ridge National Lab., TN.
OXIDATION AND REDUCTION OF Bi2Sr1.85CuO(6-y) CRYSTALS
1989 4 p Presented at the Materials Research Society Fall Meeting, Boston, MA, 27 Nov. - 2 Dec. 1989
(Contract DE-AC05-84OR-21400)
(DE90-004246; CONF-891119-44) Avail: NTIS HC A01/MF A01

The effects of oxidizing and reducing atmospheres on the oxygen content and electrical properties of Bi2Sr1.85CuO(6-y) single crystals were investigated. As-grown crystals were normally semiconducting but became metallic and superconducting after heating the crystals for several hours in oxygen at temperatures between 500 and 800 C. Previously superconducting crystals were made semiconducting by heat treatments in helium at temperatures between 700 and 780 C. Changes in the oxygen content of the crystals as well as the oxidation and reduction kinetics during the various heat treatment were monitored using standard thermogravimetric techniques. A good correlation was found between the annealing temperatures in oxygen (helium) at which there was an uptake (loss) of oxygen by the crystals 500 to 700 C and the onset (loss) of metallic behavior and superconductivity. From isothermal measurements of the weight change as a function of time, it was found that the apparent activation energy for oxidation and reduction was about 0.5 eV and 2.7 eV, respectively. A partial decomposition of the crystals during the various heat treatments, however, precluded a quantitative analysis of the kinetic data. DOE

N90-17461# Oak Ridge National Lab., TN. Solid State Div.
ELECTRICAL TRANSPORT DISSIPATION EFFECTS IN EPITAXIAL Y1Ba2Cu3O(7-x) THIN FILMS
D. K. Christen, C. E. Klabunde, R. Feenstra, D. H. Lowndes, D. Norton, H. R. Kerchner, J. R. Thompson, S. T. Sekula, J. D. Budai, and L. A. Boatner et al 1989 4 p Presented at the Materials Research Society Fall Meeting, Boston, MA, 27 Nov. - 2 Dec. 1989 Prepared in cooperation with Tennessee Univ., Knoxville, and North Carolina State Univ., Raleigh
(Contract DE-AC05-84OR-21400)
(DE90-004301; CONF-891119-38) Avail: NTIS HC A02/MF A01

The electrical transport properties were studied on a series of Y1Ba2Cu3O(7-x) thin films deposited onto single crystal substrates by thermal coevaporation and laser ablation. For fully epitaxial, c-oriented films on (001) substrate surfaces, the critical current density J(sub c) showed large high-field enhancements for the film aligned with H parallel to the copper-oxygen planes. With H(parallel)c, a precipitous decay of J(sub c) with increasing field is described by thermally activated flux motion. Films on (110) SrTiO3 substrates were comprised of finely-divided arrays of grains having zone axes (110), and groups of zone axes (103)-type orientations, and exhibited granular behavior. For these triaxial films, the transport dissipation also was thermally activated, but yielded much smaller energy barriers. DOE

N90-17462# Central Research Inst. of Electric Power Industry, Tokyo (Japan).
CONCEPTUAL DESIGN OF HIGH Tc SUPERCONDUCTING POWER CABLE AND ITS ECONOMIC EVALUATION
H. Suzuki, H. Fukagawa, and S. Akita Aug. 1988 45 p In JAPANESE; ENGLISH summary
(DE90-734940; CRIE-W-88004) Avail: NTIS (US Sales Only) HC A03/MF A01

The authors performed a conceptual design and cost evaluation of liquid nitrogen cooled superconducting power cables. They showed the results and clarified the concrete applications of high t(sub c) superconducting cables to electric power systems. They designed two types of cables, which have semi-flexible structure of three cable cores within one pipe. The optimum transmission voltage is 66kV for 2.5GVA/cct or 154kV for 5.0GVA/cct. This means an excellent economical merit of neglecting undergound power substations in the metropolitan cities. Instead of 6ccts of 275kV conventional OF cables installed in a culvert, only one circuit of 66kV liquid nitrogen cooled superconducting cable can transmit the same capacity. It was clarified that if all conventional cables in one culvert can be replaced by new cables, the transmission capacity can be increased 5 to 6 times or maximum 7.5 times. DOE

N90-17463# Central Research Inst. of Electric Power Industry, Tokyo (Japan).
IMPROVEMENT OF IMPULSE BREAKDOWN STRENGTH OF AN XLPE CABLE BY MODIFING SEMICONDUCTING LAYER
N. Hozumi, T. Okamoto, and M. Ishida Sep. 1988 18 p In JAPANESE; ENGLISH summary
(DE90-734942; CRIE-W-87041) Avail: NTIS (US Sales Only) HC A03/MF A01

A technique was investigated which reduces insulation thickness by improving breakdown strength of XLPE (cross-linked polyethylene) cables, using additives to improve interfaces of semiconducting layers, in order to restrain construction cost. Miniature model cables of 1mm insulation thick, 2mm diameter of inner semiconducting layer were manufactured. An additive was included in the semiconducting layer of each miniature cable to improve the interface with the insulating layer. The strength of dielectric breakdown was measured by testing of the impulsive pressure with lightning. The results of the impulse breakdown test show a rise in breakdown strength, indicating the effective function to make interface defects harmless. Based on the results of a previous report, a specific kind of additive which has an excellent function to improve both ac and impulse breakdown strength was selected. Additives used in this test are mainly nonionic surface active agents such as polyglyceric fatty acid esters. DOE

N90-17464# Institute of Applied Energy, Tokyo (Japan).
REVIEW OF NEW ENERGY. SUPERCONDUCTIVITY

Mar. 1989 28 p In JAPANESE
(DE90-734947; TIAE-8903) Avail: NTIS (US Sales Only) HC A03/MF A01

An summary is given of the research and development on high temperature superconductivity. It begins with a description of superconducting state and enumerates chemical elements, in particular oxides, associated with high temperature superconductivity. A brief account is next given on the progress of research and development on the present subject. Some of well known topics associated with superconductivity are described shortly, namely Meissner effect, quenching (transition to normal conducting state from superconducting one), Perovskite structure, positive hole earrier, Josephson effect, SQUID (superconducting quantum interference device) and so on. Various devices or technology are enumerated, to which superconductivity, in particular high temperature one, is proposed to apply, namely electromagnet, MRI (magnetic resonance imaging), particle accelerator, linear motor car, electric power storage and so on. The summary is finished with a future outlook. DOE

N90-17465*# Case Western Reserve Univ., Cleveland, OH. Dept. of Materials Science and Engineering.
SUPERCONDUCTING Bi1.5Pb0.5Sr2Ca2Cu3O(x) CERAMICS BY RAPID MELT QUENCHING AND GLASS CRYSTALLIZATION Final Report
Narottam P. Bansal Dec. 1989 29 p Submitted for publication
(Contract NCC3-133)
(NASA-CR-185184; E-5216; NAS 1.26:185184) Avail: NTIS HC A03/MF A01 CSCL 20L

A glass of nominal Bi(1.5)Pb(0.5)Sr2Ca2Cu3O(x) composition, prepared by rapid quenching of the melt, showed a glass transition temperature of 383 C, crystallization temperature of 446 C, melting temperature of 855 C, and bulk density of 5.69 g/cu cm in air. The activation energy for crystallization of the glass was estimated to be 292kJ/mol from non-isothermal DSC. On heating in oxygen, the glass showed a slow and continuous weight gain starting at approximately 530 C which reached a plateau at approximately 820 C. The weight gained during heating was retained on cooling to ambient conditions indicating an irreversible oxidation step. The influence of annealing conditions on the formation of various phases in the glass has been investigated. The Bi(2)Sr(2)Ca(0)Cu(1)O(6) phase crystallized out first followed by formation of other phases at higher temperatures. The high-T(sub c) phase, isostructural with Bi(2)Sr(2)Ca(2)Cu(3)O(10) was not detected below 840 C, but its fraction increased with the annealing time at 840 C. A sample annealed at 840 C for 243h in air and furnace cooled showed the highest T(sub c)(R=0) of 107.2K and a narrow transition width, delta T(sub c)(10 to 90 percent), of approximately 2 K. The high T(sub c) phase does not seem to crystallize out directly from the glass but is rather produced at high temperature by reaction between the phases formed at lower temperatures. The kinetics of 110K phase formation was sluggish. It appears that the presence of lead helps in the formation and/or stabilization of the 110 K phase. Author

N90-17466# Aerospace Corp., El Segundo, CA. Chemistry and Physics Lab.
SPECTROSCOPIC TECHNIQUES FOR THE ANALYSIS OF CdTe SUBSTRATES USED FOR THE GROWTH OF HgCdTe
D. E. Cooper, J. Bajaj (Rockwell International Science Center, Thousand Oaks, CA.), and R. C. Bowman, Jr. 25 Sep. 1989 27 p
(Contract F04701-88-C-0089)
(AD-A214545; TR-0089(4945-07)-3; SSD-TR-89-77) Avail: NTIS HC A03/MF A01 CSCL 17/5

Photoluminescence (PL) and electron paramagnetic resonance (EPR) are powerful techniques for both fundamental studies and potential materials screening of CdTe substrates for HgCdTe growth. Certain extended defects that are common in epitaxial CdTe have distinctive PL signature that correlates with x ray measurements of crystallinity. Bulk samples with prominent subgrain structure also have this PL feature, and cathodoluminescence images show that the defect is localized to the subgrain boundary regions. PL and EPR are very sensitive techniques, and specific impurities such as Fe or Ag have been observed in some nominally pure samples. PL and EPR spectroscopy can also detect changes associated with thermal annealing treatments, which alter the stoichiometry of CdTe by varying the number of Cd vacancies and interstitials. These findings illustrate the versatility of PL and EPR as nondestructive techniques to assess the quality of substrates for IR-detector materials. GRA

N90-17467# Du Pont de Nemours (E. I.) and Co., Wilmington, DE. Central Research and Development Dept.
FLEXIBILITY OF THE ZEOLITE RHO FRAMEWORK: IN SITU X RAY AND NEUTRON POWDER STRUCTURAL CHARACTERIZATION OF DIVALENT CATION-EXCHANGED ZEOLITE RHO
D. R. Corbin, L. Abrams, G. A. Jones, M. M. Eddy, W. T. A. Harrison, G. D. Stucky, and D. E. Cox (Brookhaven National Lab., Upton, NY.) 1989 58 p Sponsored in part by ONR, Washington, DC
(Contract DE-AC02-76CH-00016)
(AD-A214573; CONTRIB-4930) Avail: NTIS HC A04/MF A01 CSCL 07/4

Zeolite RHO has an unusual three dimensional monolayer surface with a topology that gives equal access to either side of the surface. In the absence of supporting structural subunits, e.g., smaller cages or channels, RHO exhibits atypical framework flexibility with large displacive rearrangements. These were investigated by in situ x ray powder diffraction studies of zeolite RHO exchanged with various divalent cations. The unit cell variation (e.g., Ca,H-RHO(400 C), a = 13.970(5)A; Sr-RHO(250 C), a = 14.045(1)A; Ba-RHO(200 C), a = 14.184(2)A; Cd-RHO(350 C), a = 14.488(3)A; Na,Cs-RHO(25 C), a = 15.031A) is a particularly sensitive function of cation and temperature. Rietveld analysis of neutron diffraction data was used to refine the structures of two samples, Ca,ND4-RHO and Ca,D-RHO. Ca,D-RHO shows the largest reported deviation from Im3m symmetry (a = 13.9645(7)A) for a RHO structure. The calcium atom is located in the center of the double 8-ring, distorting the framework to generate a tetrahedral environment. The results confirm one of the largest displacive distortions observed for a molecular sieve framework with a unit cell volume increase of 25 percent when the calcium ions of Ca,H-RHO are replaced with hydrogen ions to give H-RHO. GRA

N90-17468# IIT Research Inst., Rome, NY.
VHSIC/VHSIC-LIKE RELIABILITY PREDICTION MODELING Final Technical Report, Sep. 1986 - Dec. 1988
William K. Denson and Philip Brusius Oct. 1989 314 p
(Contract F30602-86-C-0261)
(AD-A214601; RADC-TR-89-177) Avail: NTIS HC A14/MF A02 CSCL 09/1

This report describes a study in which the objective was to develop a reliability prediction model for CMOS VHSIC and VHSIC-Like Devices. Since little field failure rate data is available on these devices, a physics of failure approach was taken in which each failure mechanism was modeled separately. The failure modes/mechanisms modeled were time-dependent dielectric breakdown, electromigration, contamination, hot carrier effects, package related mechanisms, electrical overstress, and a miscellaneous category. Each of the failure mechanisms modeled were derived from life results, screening test results, test structure data, and theoretical considerations. GRA

N90-17469# PCO, Inc., Chatsworth, CA.
THE GROWTH OF EPITAXIAL GaAs AND GaAlAs ON SILICON SUBSTRATES BY OMVPE Quarterly Report No. 10, Dec. 1988 - Feb. 1989
R. R. Bradley, J. A. Beswick, P. Kightley, D. J. Stirland, D. J. Warner, and P. Knightley Feb. 1989 31 p
(Contract N00014-86-C-2432)
(AD-A214642) Avail: NTIS HC A03/MF A01 CSCL 20/12

This report covers the period December 1988 to February 1989. The planned work for Quarter 10 was as follows: Continue growth and assessment of Gallium Arsenide/Silicon FET structures; Continue development of low temperature (approx. 900 C) silicon substrate cleaning techniques; Carry out further growth on profiled silicon substrates; Defect reducing experiments using cyclic thermal anneal routines during growth; Study the effect of substrate orientation, on nucleation and initial stages of growth; TEM studies and assessment of defect reducing experiments, nucleation, and initial stages of growth; and Design and fabrication of low complexity structures containing more than one device function. GRA

N90-17470# Stanford Univ., CA. Dept. of Materials Science and Engineering.
DIFFUSION AND DEFECT CHARACTERIZATION STUDIES OF MERCURY CADMIUM TELLURIDE Final Report, 1 Feb. 1984 - 30 Apr. 1989
David A. Stevenson Aug. 1989 129 p
(Contract N00014-84-K-0423; DARPA Order 5019)
(AD-A214655) Avail: NTIS HC A07/MF A01 CSCL 20/2

An overview is provided of the major activities for the research program on the topic of diffusion and defect chemistry of mercury cadmium telluride (MCT; Hg1-xCdxTe). Tracer self-diffusion and interdiffusion coefficients in the MCT system were measured. This provides a basis for proposed defect models for this system. A theoretical analysis based on the thermodynamics of diffusion led to new equations for interrelating the diffusion quantities in pseudobinary system, such as MCT. This analysis is consistent with the experimental information on diffusion in MCT. Epitaxial growth studies are also discussed. The isothermal vapor phase growth method was particularly emphasized. GRA

N90-17471# Lehigh Univ., Bethlehem, PA. Dept. of Physics.
POINT DEFECTS AND INTERFACES IN INSULATING SOLIDS Final Technical Report, 1 Oct. 1980 - 31 Aug. 1989
Frank J. Feigl and W. Beall Fowler 31 Aug. 1989 10 p
(Contract N00014-81-C-0005)
(AD-A214668) Avail: NTIS HC A02/MF A01 CSCL 20/2

The experimental and theoretical study of silicon dioxide and the silicon-silicon dioxide interface is presented. Important contributions were made towards understanding both bulk silicon dioxide and the interface. A number of experiments on MOS (metal-oxide-semiconductor) systems were executed. These experiments were designed to study such important features as chlorine incorporation, hydrogen migration, interface trap generation, defect structures associated with fabrication conditions, and hysteresis effects associated with charge trapping at near-interface defects. Theoretical studies were performed on bulk oxide defects, including the peroxyl radical, the non-bridging oxygen hole center, and various E' centers. In the process, the lead was taken in applying the semiempirical molecular orbital technique MINDO/3 to such defects, which others are now following. GRA

N90-17472# Michigan Univ., Ann Arbor. Dept. of Physics.
ELECTRONIC PROPERTIES OF GaAs-(Al,Ga)As QUASIPERIODIC Final Report, 1 Jun. 1986 - 31 Aug. 1989
K. Bajema and R. Merlin 27 Oct. 1989 5 p
(Contract DAAL03-86-G-0020)
(AD-A214704; ARO-23755.1-PH-F) Avail: NTIS HC A01/MF A01 CSCL 20/12

We have studied random, Fibonacci and Thue-Morse Gallium Arsenide-based superlattices using Raman scattering and other optical techniques. The non-resonant Raman data provides information on Fourier components of the modulation while resonant results reveal dips associated with gaps in the phonon spectrum. The latter have been explained in terms of a model showing that phonons with wavevector close to the zone edge and zone centers avoid the surface. GRA

N90-17473# Columbia Univ., New York, NY. Microelectronics Sciences Labs.
INTERFACIAL AND THIN FILM CHEMISTRY IN ELECTRON DEVICE FABRICATION Annual Letter Report, 1 Oct. 1988 - 30 Sep. 1989
D. Auston, G. Flynn, I. Herman, R. Osgood, N. Turro, W. Wang, and E. Yang 13 Nov. 1989 66 p
(Contract N00014-86-K-0694)
(AD-A214784) Avail: NTIS HC A04/MF A01 CSCL 20/12

Researchers developed and optimized the molecular beam epitaxy (MBE) growth parameters for the polytype InAs/AlSb/GaSb material system. Various device structures based on this material system have been explored and have yielded excellent results. New materials techniques to achieve high performance GaAs charge-coupled devices have been investigated. Use has been made of deep-UV light to enhance the oxidation rate of GaAs and we have found that the Schottky barrier height can be varied over a wide range. New physical mechanisms for light-induced reactions on semiconductor surfaces have been investigated. A new program on laser etching of SiC has begun. Laser assisted etching of copper was investigated using in situ Raman spectroscopy. A new noncontacting method of measuring the properties of space-charge depletion layers at semiconductor surfaces has been developed. Experiments were performed to study the basic chemical dynamics of chlorine atom/hydrocarbon chemical reactions. Photochemical reactions of molecules adsorbed on surfaces have been investigated. Interfacial chemistry of dry zeolites, porous molecular sieve materials, and aqueous slurries of alumina have been studied. GRA

N90-17474# Michigan Univ., Ann Arbor. Lab. of Physics.
GROWTH CHARACTERISTICS AND ELECTRONIC BEHAVIOR OF ULTRATHIN EPITAXIAL METALLIZATIONS Final Report, 1 Jul. 1986 - 31 Aug. 1989
Roy Clarke 31 Oct. 1989 5 p
(Contract DAAL03-86-G-0053)
(AD-A214794; ARO-23796.5-MS-F) Avail: NTIS HC A01/MF A01 CSCL 20/12

A summary of research findings is presented on a project to study the use of Molecular Beam Epitaxy Techniques in metallization of semiconductors such as Gallium Arsenide. Epitaxial metal layers of Niobium and Tantalum have been grown on sapphire and overlayers of Germanium, Gold, Copper and Cobalt have been deposited on (110) and (100) GaAs. The interfacial structure and defects have been studied using x ray scattering and transmission electron microscopy. GRA

N90-17475# Hughes Research Labs., Malibu, CA.
REACTIVE ATMOSPHERE PROCESSING OF BaTiO3 AND ORIGINS OF ITS PHOTOREFRACTIVE EFFECT Final Technical Report, Dec. 1983 - Jul. 1985
M. B. Klein and B. A. Wechsler Apr. 1989 118 p
(Contract F19628-84-C-0069; AF Proj. D800)
(AD-A215034; RADC-TR-88-199) Avail: NTIS HC A06/MF A01 CSCL 17/2

Photorefractive materials offer great promise for applications in optical data processing and phase conjugation using degenerate four-wave mixing. BaTiO3 is a particularly promising material, primarily because the very large value of the electro-optic tensor component r42 yields correspondingly large values of grating efficiency, beam coupling gain, and four-wave mixing reflectivity. Unfortunately, the commercial availability of BaTiO3 crystals is limited, and samples which are available are relatively small and impure and have not been characterized or optimized for photorefractive applications. In the program reviewed here, two of the most important problems in the development and use of photorefractive BaTiO3 are addressed: stabilization of the cubic phase in order to permit more rapid crystal growth than is now possible, and determination and characterization of the photorefractive species in commercial BaTiO3. The second major effort of this program was the identification and characterization of the photorefractive species in BaTiO3. Using the results of a number of experiments, it was concluded that iron (in the forms

Fe2+ and Fe3+) is the dominant photorefractive species in commercial BaTiO3. The densities of Fe2+ and Fe3+ were measured along with the sign of the photocarriers, the effective electro-optic coefficient, and a lumped parameter taking into account the transport properties of holes and electrons. GRA

N90-17476# Stanford Univ., CA. Solid State Electronics Lab.
JSEP (JOINT SERVICES ELECTRONICS PROGRAM) Annual Report, 1 May 1988 - 30 Jun. 1989
James S. Harris, Jr. 30 Jun. 1989 77 p
(Contract DAAG29-85-K-0048)
(AD-A215051) Avail: NTIS HC A05/MF A01 CSCL 09/1

The areas of research are summarized, the most significant results are identified, and the publications and dissertations which resulted from this work are listed. Some topics of research are: Molecular Beam Epitaxy of High Tc Superconductors and Investigation of Quantum Well Structures, Physics and Applications of Ultra-Small, High Temperature Superconductors, Reactive Ion Profiling of Heterostructures, GaAs on Si Integrated Circuits, The Electronic Structure of High Temperature Superconductors, Semiconductor Laser with UltraLow Threshold Current, Device Physics and Technology of Silicon Based Heterostructures, MOS Devices Based on the GexSi1-x/Si Materials System, Combined Equalization and Coding, and Real Time Statistical Signal Processing. GRA

N90-17477# Illinois Univ., Urbana. Dept. of Electrical and Computer Engineering.
CARBON DOPING OF COMPOUND SEMICONDUCTOR EPITAXIAL LAYERS USING CARBON TETRACHLORIDE Final Report, 21 Aug. 1986 - 20 Aug. 1989
Brian T. Cunningham and Gregory E. Stillman 13 Nov. 1989 7 p
(Contract DAAL03-86-G-0047)
(AD-A215053; UILU-ENG-89-2504; ARO-23789.2-EL-F) Avail: NTIS HC A02/MF A01 CSCL 09/1

H2 has been used as a carbon dopant source for AlxGa1-xAs grown by low pressure metalorganic chemical vapor deposition (MOCVD). To understand the mechanism for carbon incorporation from CC14 doping, and to provide experimental parameters for the growth of carbon doped device structures, the effect of various crystal growth parameters on CC14 doping have been studied, including growth temperature, growth rate, V/VIII ratio, Al composition, and CC14 flow rate. Although CC14 is an effective p-type dopant for MOCVD AlxGa1-xAs, injection of CC14 into the reactor during growth of InP resulted in no change in the carrier concentration or carbon concentration from undoped InP layers. Abrupt, heavy carbon doping spikes in GaAs have been obtained using CC14 without a dopant memory effect. By annealing samples with carbon doping spikes grown within undoped, n-type, and p-type GaAs, the carbon diffusion coefficient in GaAs at 825 C has been estimated and has been found to depend strongly on the GaAs background doping. CC14 doping has been used in the base region of an Npn AlGaAs/GaAs heterojunction bipolar transistor (HPT). HPTs with 3 x 10 m self-aligned emitter fingers have been fabricated which exhibit a current gain cutoff frequency of ft = 26 GHz. GRA

N90-17478# Department of the Navy, Washington, DC.
METHOD OF PRODUCING A THIN SILICON-ON-INSULATOR LAYER Patent Application
David J. Godbey, inventor (to Navy), Harold L. Hughes, inventor (to Navy), and Francis J. Kub, inventor (to Navy) 29 Sep. 1989 18 p
(AD-D014330; US-Patent-Appl-SN-414225) Avail: NTIS HC A02/MF A01 CSCL 09/1

A process for fabricating thin film silicon wafers using a novel etch stop composed of a silicon-germanium alloy includes properly doping a prime silicon wafer for the desired application, growing a strained Si(1-x)Ge(x) alloy layer onto seed wafer to serve as an etch stop, growing a silicon layer on the strained alloy layer with a desired thickness to form the active device region, oxidizing the prime wafer and a test wafer, bonding the oxide surfaces of the test and prime wafers, machining the backside of the prime wafer and selectively etching the same to remove the silicon, removing the strained alloy layer by a non-selective etch, thereby leaving the device region silicon layer. In an alternate embodiment, the process includes implanting germanium, tin, or lead ions to form the strained etch stop layer. GRA

N90-17479# Centre National d'Etudes des Telecommunications, Lannion (France).
WORKSHOP ON HYDROGEN EFFECTS IN InP AND RELATED COMPOUNDS
25 Oct. 1989 54 p Workshop held in Lannion, France, 24-25 Oct. 1989
(AD-A215197) Avail: NTIS HC A04/MF A01 CSCL 09/3

The use of plasma hydrogenation for decreasing the conductivity of p-type InP by several orders of magnitude was the object of recent reports. The physical phenomenon involved is the neutralization of electrically active acceptors by the in-diffused hydrogen species with the formation of hydrogen acceptor pairs as detected by infrared vibrational spectroscopy. An obvious application of this effect is the realization of electrical isolation in various electronic and optoelectronic InP-based devices. The BRS laser technology makes use of proton-implantation in order to enhance the output efficiency by reducing the current leaks across the InP/InP homojunction. While proton implantation provides adequate electrical insulation, it is also likely to introduce defects which can act as nonradiative centers. Preliminary characterization of high performance lasers by plasma hydrogenation instead of proton implantation was realized for the first time. GRA

N90-17480# Stanford Univ., CA. Dept. of Applied Physics.
INTERNATIONAL CONFERENCE ON MATERIALS AND MECHANISMS OF SUPERCONDUCTIVITY: HIGH TEMPERATURE SUPERCONDUCTORS Final Technical Report, 15 Mar. 1989 - 14 Mar. 1990
T. H. Geballe Oct. 1989 36 p Conference held in Stanford, CA, 23-28 Jul. 1989
(Contract N00014-89-J-1837)
(AD-A215343) Avail: NTIS HC A03/MF A01 CSCL 20/3

The proceedings included herewith represent the contributions of ONR speakers at the International Meeting on the Materials and Mechanisms of Superconductivity. High Temperature Superconductors. The following speakers and topics are included: J. R. Clem, Phenomenological Theory of Magnetic Structure in the High-Temperature Superconductors; V. Kogan, Anisotropy in Magnetic Properties of High-Tc Materials; D. R. Nelson, Melted Flux Liquids in High Tc Superconductors; C. G. Olson, High Resolution-Angle Resolved Photoemission Studies of High Temperature Superconductors; S. C. Zhang, Spin Fluctuations, Spin Bags and the High Tc Superconductivity; A. W. Sleight, Crystal Chemistry of Oxide Superconductors; Y. J. Uemura, Probing Magnetism and Superconductivity of High-Tc Systems with Positive Muons. GRA

N90-17481# Utah Univ., Salt Lake City. Dept. of Physics.
STRUCTURAL INSTABILITIES, IMPURITIES, AND DEFECTS IN ELECTRONIC MATERIALS Final Report, 15 Aug. 1987 - 30 Sep. 1989
P. C. Taylor and William D. Ohlsen 30 Sep. 1989 24 p
(Contract N00014-83-K-0535)
(AD-A215384) Avail: NTIS HC A02/MF A01 CSCL 20/12

Defects and impurities in III-V binary, ternary and quaternary semiconducting films made by the organometallic vapor phase epitaxial (OMVPE) technique are examined. An investigation is made of III-V multilayers and quantum well structures. An investigation is also made of photo-induced structural changes in amorphous semiconductors. All topics utilized optical and magnetic resonance techniques included electron spin resonance (ESR), nuclear magnetic resonance (NMR), optically-pumped NMR and ESR, optically detected magnetic resonance (ODMR), photoluminescence (PL), optical absorption and various modulated optical spectroscopies such as thermally modulated PL. Recent interest in strained-layer superlattices and quantum wells has been

motivated by their potential for high speed devices. The PL measurements have demonstrated a useful diagnostic technique to measure critical thicknesses in strained layer heterostructures. The thermally modulated photoluminescence measurements on InP/GaInAs/InP single quantum wells where the well widths are as small as about 3 have demonstrated this trend for the first time. The PIn antisite in InP was first identified by ESR. GRA

N90-17482# Arizona State Univ., Tempe.
PROCEEDINGS OF THE CONFERENCE ON HOT CARRIERS IN SEMICONDUCTORS Final Report
David K. Ferry and Gerald J. Iafrate Nov. 1989 74 p Conference held in Scottsdale, AZ, 23-28 Jul. 1989
(Contract DAAL03-88-G-0045)
(AD-A215544; ARO-26093.1-EL-CF) Avail: NTIS HC A04/MF A01 CSCL 20/12

Topics contained included: Resonant Tunneling in Heterojunction Barriers; Multivalued hot electron distributions as spontaneous symmetry breaking; Intersubband emission from superlattices; Nonequilibrium effects in quasi-one dimensional weak localization; Hot electron transport in high-lying minibands in semiconductor superlattices; High-field transport and NDR with hot phonons in degenerate semiconductors; Magneto-phonon resonances in the effective temperature of photo-excited carriers in GaAs/(Ga,Al)As quantum wells; The one-dimensional quantized ballistic resistance in GaAs/AlGaAs heterojunctions with varying experimental conditions; Femtosecond excitations in electrons in A3B5 semiconductors and QW structures; Determination of scattering times on the femtosecond time scale; electron gases; Gamma intervalley-interlayer scattering rates in type 2 GaAs/AlAs superlattices; Photoluminescence of hot electrons in A3B5 semiconductors and QW structures; Determination of scattering times on the femtosecond time scale; Hot Carriers in Bulk Materials; Quantum Transport and Modeling; Resonant Tunneling; Chaos, Instabilities, and Impact Ionization; and Semiconductor Devices. GRA

N90-17483# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
EXCITED STATE LIFETIME MEASUREMENTS OF YTTERBIUM IN INDIUM PHOSPHIDE M.S. Thesis
David Desrocher Dec. 1989 81 p
(AD-A215709; AFIT/GEP/ENP/89D-2) Avail: NTIS HC A05/MF A01 CSCL 20/12

The AFIT Time Resolved Photoluminescence (TRPL) lab was disassembled, relocated and rebuilt with improvements to layout and performance. Excited state lifetime measurements of ytterbium implanted in indium phosphide were conducted using the new lab. Effects of sample temperature, rapid thermal annealing (RTA) time and RTA temperature on the lifetimes of the 1.002 microns Yb3+ line were examined. Lifetime measurements of Er, Pr and Tm in GaAs were also attempted. Ytterbium concentrations were 3 x 10(exp 13) ions/sq cm, implanted at an ion energy of 1 MeV in semi-insulating InP substrate. Sample temperatures ranged from 4.2 to 90K. Annealing times ranged from 1 to 25 seconds on samples annealed at 850 C. Annealing temperatures ranged from 400 to 850 C, with RTA times of 15 seconds. The excitation source was a nitrogen-pumped dye laser with primary wavelength at 580 nm. A germanium photodiode detector was selected to eliminate the long time constant associated with available S1 power supplies and to enable detection at the near infrared wavelengths of the other rare earths. Data acquisition was accomplished with a boxcar averager and a microcomputer equipped with acquisition hardware and software. Thermal quenching was clearly observed in lifetimes at increasing sample temperatures, most dramatically at above 50 C. The results would be very helpful in device fabrication/operation considerations, and some of the sample preparation parameters may be equally applicable for other RE doped III-V semiconductors. GRA

N90-17484# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
LOW TEMPERATURE PHOTOLUMINESCENCE STUDY OF URANIUM IMPLANTED INTO III-V SEMICONDUCTORS AND AlGaAs M.S. Thesis
Michael B. Scott 4 Dec. 1989 67 p
(AD-A215710; AFIT/GEP/ENP/89D-9) Avail: NTIS HC A04/MF A01 CSCL 20/12

Actinides, like lanthanides, have a partially filled inner shell (5f for actinides) so that semiconductors implanted with these elements should have sharp emissions characteristic of the atomic transitions of the free element ions. II-V semiconductors Gallium Arsenide, Gallium Phosphide, and Indium Phosphide and ternary Al(0.15)Ga(0.85)As were ion implanted with Uranium 238. Uranium-associated emissions were observed in the near infrared region in each semiconductor type except for n-type GaP. The uranium emissions in n-type GaP were too weak to confirm. An annealing temperature dependence study and a sample temperature dependence study were done to associate emissions to specific centers and observe thermal quenching. No effects by the doping of uranium were observed in the band edge emissions except in semi-insulating (SI) InP:U. The optimum annealing temperature for SI-GaAs, SI-InP, and n-type Al(0.15)Ga(0.85)As was 700 C. For n-type GaAs, the optimum annealing temperature was 7500 C. The increase in emission intensities with higher annealing temperature suggests a lattice site luminescence center. The similar intensity dependence on sample temperature by each Uranium emission in each semiconductor, implies a single luminescence center. The weakness of uranium emissions shows that uranium-doped semiconductors must be modified to significantly improve the quantum efficiency of the radiation transfer process before they can be seriously considered for use in devices. GRA

N90-17485# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
SELECTIVE EXCITATION LUMINESCENCE AND PHOTOLUMINESCENCE INVESTIGATIONS OF YTTERBIUM DOPED InP, GaAs AND AlGaAs M.S. Thesis
Michael L. Eastman Dec. 1989 84 p
(AD-A215713; AFIT/GEP/ENP/89D-3) Avail: NTIS HC A05/MF A01 CSCL 20/12

Group III-V semiconductors doped with rare earth (RE) elements produce sharp emissions that would be ideally suited to Air Force optoelectronic applications. The sharp emissions are due to the intra-4f transitions of the triply ionized Re atom that are partially shielded from the crystal lattice potential by the outer lying 5s and 5p electrons. The Re element ytterbium (Yb) was implanted into bulk grown InP, vapor phase epitaxial (VPE) grown InP, GaAs, and Al(x)Ga(1-x)As with x = .15, .23, and .30. The samples were annealed using rapid thermal annealing (RTA) or conventional furnace annealing (CFA) for a range of temperatures and times. The study of bulk InP:Yb evaluated the emission spectra intensity as a function of temperature and excitation energy. Temperatures from 2.8K to 90K and energies from 1.38 to 1.495 eV were used. The results of this analysis confirm that the majority of the Yb related spectra is from only one luminescent center. GRA

N90-17486# State Univ. of New York, Buffalo. Center for Electronic and Electro-Optic Materials.
DENSITY OF ELECTRONIC STATES IN A BIASED RESONANT TUNNELING STRUCTURE
L. N. Pandey, D. Sahu, and Thomas F. George Nov. 1989 20 p Submitted for publication
(Contract N00014-86-K-0043)
(AD-A215735; UBUFFALO/DC/89/TR-117) Avail: NTIS HC A03/MF A01 CSCL 20/12

The change in density is calculated of states due to a biased resonant tunneling structure. The maximum of the density of states near resonance gets shifted towards the low energy side compared to the unbiased case, as is the transmission coefficient, although the two need not be identical. For the case of asymmetric barrier

heights, the left-right symmetry of the density states is broken when the field is non-vanishing. GRA

N90-17487*# Clarkson Univ., Potsdam, NY. Center for Advanced Materials Processing.
MODELLING DIRECTIONAL SOLIDIFICATION Final Report, 1 Sep. 1985 - 31 Aug. 1989
William R. Wilcox 16 Feb. 1990 172 p
(Grant NAG8-541)
(NASA-CR-186181; NAS 1.26:186181) Avail: NTIS HC A08/MF A01 CSCL 20L

The long range goal is to develop an improved understanding of phenomena of importance to directional solidification, to enable explanation and prediction of differences in behavior between solidification on Earth and in space. Emphasis during the period of this grant was on experimentally determining the influence of convection and freezing rate fluctuations on com positional homogeneity and crystalline perfection in the vertical Bridgman-Stockbarger technique. Heater temperature profiles, buoyancy-driven convection, and doping inhomogenieties were correlated using naphthalene doped with azulene. In addition the influence of spin-up/spin-down on compositional homogeneity and microstructure of indium gallium antimonide and the effect of imposed melting-freezing cycles on indium gallium antimonide are discussed. Author

N90-17488# Oak Ridge National Lab., TN. Solid State Div.
OPTICAL WAVEGUIDE FABRICATION BY STOICHIOMETRIC IMPLANTATION OF Ti AND O INTO LiNbO3
D. B. Poker and W. Xia (California Univ., San Diego.) Nov. 1989 6 p Presented at the Materials Research Society Fall Meeting, Boston, MA, 27 Nov. - 2 Dec. 1989 Submitted for publication
(Contract DE-AC05-84OR-21400)
(DE90-004238; CONF-891119-45) Avail: NTIS HC A02/MF A01

X-cut substrates of LiNbO3 were implanted at 500 C with Ti and O to doses of 2.5 and 7.5 x 10(exp 17) ions/sq cm, respectively. The high substrate temperature during implantation ensures dynamic recrystallization, preserving the crystallinity of the LiNbO3. The stability of the stoichiometric implants is enhanced sufficiently that annealing at 1000 C proceeds with no surface degradation of the substrate. Annealing under identical conditions without the O implant usually results in phase separation of an oxide at the surface, even when annealing is performed immediately following implantation. Samples implanted with Ti and O to preserve the stoichiometric metal:oxygen ratio of the substrate can be stored at room temperature for several months without phase separation. Planar optical waveguides have been produced by stoichiometric implantation followed by annealing in water-saturated oxygen for one hour at temperatures of 900 and 1000 C. The sample annealed at 900 C supported a single lossy mode, while the 1000 C sample supported two propagating modes and one lossy mode at lambda = 0.6 micrometer. DOE

N90-17489# Los Alamos National Lab., NM.
NORMAL STATE ELECTRONIC STRUCTURE AND THE SUPERCONDUCTING ENERGY GAP IN HTSC'S AS DETERMINED FROM PHOTOEMISSION SPECTROSCOPY
A. J. Arko, R. S. List, R. J. Bartlett, S.-W. Cheong, Z. Fisk, J. D. Thompson, C. G. Olson, A.-B. Yang, R. Liu, and C. Gu et al 1989 8 p Presented at the 2nd International Symposium on Superconductivity, Tsukuba, Japan, 14-17 Nov. 1989
(Contracts W-7405-eng-36; W-7405-eng-82; W-31-109-eng-38; NSF DMR-86-01349; NSF STC-88-0954)
(DE90-004857; LA-UR-89-4190; CONF-891137-2) Avail: NTIS HC A02/MF A01

Photoemission spectroscopy was utilized to determine the electronic structure of high-T(sub c) materials. The observation of dispersive bands at E(sub F) suggests a Fermi surface similar to that obtained from a band calculation. The results apparently are not inconsistent with the notion of a correlated Fermi liquid consisting of hybridized p-d bands. However, it is becoming more and more difficult to distinguish between Fermi liquid behavior in the new high-T(sub c) superconductors and behavior expected on the basis of the novel new non-Fermi liquid theories. The differences are now predicted to be on an energy scale smaller than the experimental resolution. It is pointed out that, while deviations from simple band theory certainly do exist in the form of core and valence band satellites, band narrowing, and rapid photoemission peak broadening away from E(sub F), there are sufficient agreements with the overall DOS that it should be considered a good starting point for the electronic structure. For example, the calculated Fermi surface for both the 123 and 2212 structures is reasonably well reproduced experimentally and the bands at E(sub F) consist of p-d hybridized orbitals just as predicted by local density functional theory. The spectra clearly show that a BCS-like DOS is obtained at the Fermi energy as a gap opens up below T(sub c). This is just one more indication that the old conventional models should be considered more seriously. DOE

N90-17490# Los Alamos National Lab., NM.
THE USE OF BaF2 BUFFER LAYERS FOR THE SPUTTER-DEPOSITION OF TlCaBaCuO THIN-FILM SUPERCONDUCTORS
Kevin M. Hubbard, Paul N. Arendt, David R. Brown, D. Wayne Cooke, Norman E. Elliott, J. Douglas Farr, Michael Nastasi, Kevin C. Ott, Eric J. Peterson, and Gary A. Reeves 1989 5 p Presented at the Materials Research Society Fall Meeting, Boston, MA, 27 Nov. - 2 Dec. 1989 Submitted for publication
(Contract W-7405-eng-36)
(DE90-004859; LA-UR-89-4205; CONF-891119-50) Avail: NTIS HC A02/MF A01

Thin films of the Tl-based superconductors often have relatively poor properties because of film/substrate interdiffusion which occurs during the anneal. The use of BaF2 was investigated as a diffusion barrier. TlCaBaCuO thin films were deposited by dc magnetron sputtering onto MgO (100) substrates, both with and without an evaporation-deposited BaF2 buffer layer, and post-annealed in a Tl over-pressure. Electrical properties of the films were determined by four-point probe analysis, and compositions were measured by ion-backscattering spectroscopy. Structural analysis was performed by x ray diffraction and scanning electron microscopy. The BaF2 buffer layers were found to significantly improve the properties of the TlCaBaCuO thin films. DOE

N90-17491# Argonne National Lab., IL. Materials Science Div.
HIGH-TEMPERATURE DEFORMATION OF YBa2Cu3O(7-DELTA) WITH Ag ADDITIONS
J. L. Routbort, K. C. Goretta, and J. P. Singh 1989 5 p Presented at the Materials Research Society Fall Meeting, Boston, MA, 27 Nov. - 2 Dec. 1989
(Contract W-31-109-eng-38)
(DE90-004884; CONF-891119-56) Avail: NTIS HC A02/MF A01

The steady-state flow stress of YBa2Cu3O(7-delta) containing 15 to 30 vol. percent Ag was measured in air at nearly constant compressive strain rates between 5 x 10(exp-6) and 1 x 10(exp-4)/s from 830 to 900 C. Addition of Ag dramatically decreases the flow stress compared to that of the pure superconductor, but the stress exponents and the activation energy for deformation remain unchanged. DOE

N90-17492# Illinois Univ., Urbana-Champaign. Dept. of Ceramic Engineering.
EVOLUTION OF STRUCTURE AND ELECTRICAL PROPERTIES DURING CRYSTALLIZATION OF RAPIDLY SOLIDIFIED Bi4Ti3O12 Ph.D. Thesis
Lorri Drozdyk Jun. 1989 236 p
(Contract DE-AC02-76ER-01198)
(DE90-005221; DOE/ER-01198/T41) Avail: NTIS HC A11/MF A02

Amorphous Bi4Ti3O12 was prepared by rapid solidification from the melt. Crystallization and microstructure development during heat treatment were investigated. Dielectric and ferroelectric properties were related to microstructure. The method of materials

preparation led to interesting and desirable properties for amorphous and crystallized fine-grain electrical ceramics. Crystallization behavior during heat treatment was investigated by DSC, XRD, and TEM. Direct transformation to the expected crystalline phase occurred without any major intermediary steps. Transformation kinetics were determined by a variety of techniques, and the kinetic parameters were dependent on the method used. Fully crystallized material had structure and electrical properties which were dependent on the heat treatment conditions. For materials heat treated at 600 C and above, the microstructures were dense, and with a uniform fine-grain size of less than 1 micrometer. The structures had residual strain. For decreasing heat treatment temperature, a decrease in grain size was observed, with an increase in strain, and a decrease in occurrence of domains. In addition to the observations for microstrain and domains, features of the dielectric anomaly at the Curie temperature implied increasing internal stress for materials heat treated at lower temperature. Ferroelectric hysteresis was observed for fully crystallized material. However, saturation was not possible for materials which were heat treated at 600 C and below. Coercive fields for fine-grain material were higher than for single crystal material, and materials with smaller grain sizes had higher coercive fields. DOE

N90-17493# Rochester Univ., NY. Dept. of Physics and Astronomy.
FLUX FLOW, PINNING, AND RESISTIVE BEHAVIOR IN SUPERCONDUCTING NETWORKS Annual Progress Report No. 1, 1 May 1989 - 30 Apr. 1990
Stephen Steitel Dec. 1989 6 p
(Contract DE-FG02-89ER-14017)
(DE90-005242; DOE/ER-14017/1) Avail: NTIS HC A02/MF A01

The behavior of superconducting networks is studied in terms of XY and Coulomb gas models. The dynamics of frustrated Josephson junction arrays was simulated, and good agreement found with experiment. Results were explained in terms of a simple picture of vortex excitations. The three dimensional XY model was simulated, as a model for fluctuation effects in high Tc superconductors. In a simple limit, corresponding to no applied magnetic field, good agreement was found with results obtained by previous methods. The two dimensional classical integer Coulomb gas was simulated. New critical behavior was found in the dense charge limit, arising from the effects of highly correlated charges. DOE

N90-17494# Oak Ridge National Lab., TN.
HARDNESS-DAMAGE CORRELATIONS IN Ta IMPLANTED SINGLE CRYSTAL Ni3Al
Gary S. Was, Siegfried Mantl (Kernforschungsanlage, Juelich, Germany, F.R.), and Warren Oliver 1989 7 p Presented at the Materials Research Society Fall Meeting, Boston, MA, 27 Nov. - 2 Dec. 1989
(Contract DE-AC05-84OR-21400)
(DE90-005270; CONF-891119-64) Avail: NTIS HC A02/MF A01

Implantation of Ta into single crystal Ni3Al was conducted to determine whether this would be an effective means of producing surface hardening in monolithic alloys. Ta was implanted at 400 keV to doses of 0.7, 3.6 and 25.2 x 10(exp 15)/sq cm along the (100) axis of a (100) crystal of Ni3Al at room temperature. Composition vs depth profiles were determined by RBS and lattice location of Ta was determined by channeling angular yield scans about the (100) axis. The hardness of the surface was measured by ultra-low load indentation. Results show that implantation softens the surface and that the Ta is randomly distributed between Ni and Al sites. Annealing at 1000 C/0.25 h increases the surface hardness substantially. The results indicate that the as-implanted surface is softened by disordering and subsequent diffusion of Ta and Al sites causes hardening of the surface. DOE

N90-17495# Sandia National Labs., Albuquerque, NM.
EFFECTS OF O2 ION BOMBARDMENT OF Y-BaCu-OXIDE DURING THIN FILM GROWTH
G. Metzger (New Mexico Univ., Albuquerque.) and C. B. Fleddermann 1989 11 p Presented at the Materials Research Society Fall Meeting, Boston, MA, Oct. 1989
(Contract DE-AC04-76DP-00789; NSF MSME-87-18132)
(DE90-005315; SAND-90-0059C; CONF-8910336-1) Avail: NTIS HC A03/MF A01

Oxygen ion beam bombardment was studied as a means for incorporating oxygen into thin films of Y-Ba-Cu-oxide either by enhancing the transport of oxygen to substrates during ion-beam sputtering, or by direct incorporation of oxygen by ion-assisted deposition. Optical emission spectroscopy was used to study the ion-beam bombardment of bulk superconducting targets as the oxygen content of the ion beam was varied between 0 percent (pure argon) and 100 percent oxygen. This showed that oxygen did not directly combine with metallic elements in the target to increase the oxygen content of the stream of particles moving toward the substrate. The oxygen content of the sputter beam did, however, change the relative emission intensity from the various target components. Addition of a second ion beam directing an oxygen beam toward the substrate as the film is grown, caused large variations in the stoichiometry of the deposited films. At low ion currents, no increase in the oxygen content of the films was detected, while at relatively high currents, the oxygen incorporation increased. However, the sputtering of the metallic components of the film increased, leading to very low growth rates. DOE

N90-17496# Argonne National Lab., IL. Materials Science Div.
EPITAXIAL GROWTH OF Cr(011) ON LiF(001)
J. Mattson, M. B. Brodsky, J. Ketterson, and H. You 1989 6 p Presented at the Materials Research Society Fall Meeting, Boston, MA, 27 Nov. - 2 Dec. 1989
(Contract W-31-109-eng-38)
(DE90-005635; CONF-891119-69) Avail: NTIS HC A02/MF A01

We report x ray diffraction and in-situ RHEED (Reflection High Energy Electron Diffraction) measurements on Cr thin films deposited on LiF (001) single crystal substrates for thicknesses up to 300 nm and for substrate temperatures from 30 to 450 C. From these measurements we determine the range of deposition conditions necessary for epitaxial growth and the stress in these films as a function of film thickness. DOE

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N90-17497*# Fermi National Accelerator Lab., Batavia, IL.
FALSE VACUUM DECAY IN JORDAN-BRANS-DICKE COSMOLOGIES
Richard Holman, Edward W. Kolb, Sharon L. Vadas, Yun Wang, and Erick J. Weinberg (Columbia Univ., New York, NY.) Dec. 1989 12 p
(Contracts NAGw-1340; DE-AC02-76ER-03066; DE-AC02-76ER-02271)
(NASA-CR-186257; NAS 1.26:186257; FERMILAB-Pub-89/223-A; CMU-HEP89-24; CU-TP-453) Avail: NTIS HC A03/MF A01 CSCL 20C

The bubble nucleation rate in a first-order phase transition taking place in a background Jordan-Brans-Dicke cosmology is examined. The leading order terms in the nucleation rate when the Jordan-Brans-Dicke field is large (i.e., late times) are computed by means of a Weyl rescaling of the fields in the theory. It is found that despite the fact that the Jordan-Brans-Dicke field (hence the effective gravitational constant) has a time dependence in the false vacuum at late times the nucleation rate is time independent. Author

N90-17498# Laboratorio de Computacao Cientifica, Rio de Janeiro (Brazil).
EXISTENCE OF BOSE-EINSTEIN CONDENSATION IN ONE AND TWO DIMENSIONS
A. C. Olinto Oct. 1988 14 p
(DE89-635910; LNCC-035/88; ISSN-0101-6113) Avail: NTIS (US Sales Only) HC A03/MF A01

It is shown that in Bose condensed systems the f-sum rule has an additional term due to the condensate reservoir. As a result of this new sum rule and an exact Bogoliubov inequality, Bose-Einstein condensation in repulsively interacting systems may occur in one and two dimensions. DOE

N90-17499# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.
CHAOS AND TURBULENCE Final Report, 1 Feb. 1985 - 31 Aug. 1989
31 Aug. 1989 3 p
(Contract N00014-85-K-0205)
(AD-A215310) Avail: NTIS HC A01/MF A01 CSCL 20/4

The main research effort was an attempt to find low order systems possessing chaotic behavior which could successfully model turbulent flow. The reason for searching for low order systems is the strongly suggestive evidence that chaos disappears in systems with a large number of degrees of freedom. Recent work on symplectic integration of Hamiltonian systems indicates that for Hamiltonian systems chaos may be no more than numerical error growing exponentially, and is absent when the numerical scheme conserves the Poincare invariants and the symplectic structure. A great deal was learned about vortical solutions of the Navier-Stokes equations and new solutions of a weakly nonlinear approximation were found, which suggest the existence of Navier-Stokes solutions which will describe a vortical description of the laminar turbulent interface. An interesting application of dynamical system theory to a problem of kinematic mixing showed that the use of these ideas could reduce the dimension of the system in order to make computations feasible, and predict the qualitative development of the distribution of mixed tracer in an unsteady flow. GRA

N90-17500# North Carolina Univ., Chapel Hill. Dept. of Physics and Astronomy.
RESEARCH IN THEORETICAL PHYSICS
P. H. Frampton 1989 16 p
(Contract DE-FG05-85ER-40219)
(DE90-005605; DOE/ER-40219/4) Avail: NTIS HC A03/MF A01

The following topics are discussed: strings and gravity; particle phenomenology; field theories; and cosmology. DOE

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

No abstracts in this category.

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N90-17501# Riverside Research Inst., Arlington, VA.
TECHNOLOGY MATURITY ASSESSMENT METHODOLOGY SDIO SYSTEMS SETA Report No. 1, period ending 15 Sep. 1989
20 Sep. 1989 14 p
(Contract SDI084-88-C-0019)
(AD-A214571; CDRL-A347) Avail: NTIS HC A02/MF A01 CSCL 15/3

A development program can be described and evaluated by three interrelated parameters: cost, schedule, and technical performance. These parameters can be visualized as the x, y, and z axes of a 3-D space. A program's desired objective, usually represented by a conceptual design, is a point in the 3-D space defined by the estimated or target values for cost, schedule, and desired technical performance of this conceptual design. To reach this goal, a series of events is laid out which defines the development path. Each event contains its own cost, schedule, and technical performance characteristics. Ideally, the summation of the individual event parameters equals the whole. It is impractical, if not impossible, to condense most programs to a single cost, schedule, and technical performance parameter. However, it is often possible to condense myriad development activities into a series of key activities and events which provide a reasonably accurate depiction of the overall program. Because of the uncertainty of predicting the outcome of future events, almost from the moment a program is baselined, programmatic forces tend to impose changes on the baseline parameters. This is especially true of research and development programs, like the Strategic Defense Initiative, where many projects are pushing the frontiers of science and technology. GRA

N90-17502# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
AN INVESTIGATION INTO THE EFFECTS WHICH AEROSPACE INDUSTRY OFFSET TRADE AGREEMENTS HAVE ON UNITED STATES AIR FORCE MISSION PERFORMANCE M.S. Thesis
Douglas M. Crabb Sep. 1989 163 p
(AD-A215093; AFIT/GLM/LSM/89S-11) Avail: NTIS HC A08/MF A01 CSCL 05/4

The purpose of this study was to contribute to the understanding of the subject of aerospace industry offset trade agreements and their effect on USAF mission performance. This study had two objectives: (1) identify those offset effects that might impact USAF mission performance, and (2) describing how these effects could change the ability of the USAF to perform its mission. This thesis did not determine the magnitude of the offset effects, and it did not identify solutions to remedy any negative effects. Analysis of available literature and responses to research questions revealed that offsets have a wide range of effects on USAF mission performance. While definitive negative and position effects where identified and validated, it was discovered that the purported impact of certain effects, either negative or positive, was dependent upon the viewer's frame of reference. These perceived effects are at the heart of the government and industry debate over offsets. This study also found that the debate over the real impact of these perceived effects is greatly confused by the lack of a coordinated U.S. government policy concerning offsets, as well as the absence of a comprehensive centralized database containing offset related data. These findings are disturbing because of the potential magnitude of the impact which the perceived effects could have on USAF mission performance. GRA

N90-17503# Department of Defense, Washington, DC.
DEFENSE SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAM: PROGRAM SOLICITATION 90.1, FY-1990
1 Oct. 1989 445 p
(AD-A215350) Avail: NTIS HC A19/MF A03 CSCL 05/1

The Army, Navy, Air Force, Defense Advanced Research Projects Agency (DARPA), Defense Nuclear Agency (DNA), and Strategic Defense Initiative Organization (SDIO), hereafter referred to as DoD Components, invite small business firms to submit proposals under this program solicitation entitled Small Business Innovation Research (SBIR). Firms with strong research and development capabilities in science or engineering in any of the topic areas described in Appendix D are encouraged to participate. Subject to availability of funds, DoD Components will support high quality research or research and development proposals of innovative concepts to solve the listed defense related scientific

or engineering problems. Objectives of the DoD SBIR Program include stimulating technological innovation in the private sector, strengthening the role of small business in meeting DoD research and development needs, fostering and encouraging participation by minority and disadvantaged persons in technological innovation, and increasing the commercial application of DoD-supported research or research and development results. GRA

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

N90-17504 Houston Univ., TX.
AN INVESTIGATION OF APPLICATION DEVELOPMENT PROCESS CONTROLS IN AN END-USER SETTING: A FIELD STUDY Ph.D. Thesis
Brent J. Bowman 1988 304 p
Avail: Univ. Microfilms Order No. DA8906813

A laboratory experiment demonstrated that end-user application development controls can have significant effects on important end-user computing outcomes for a simulated development project (Alavi, Phillips, and Freedman, 1986). This experiment utilized a recent perspective on organizational control which posits that controls may be characterized as being primarily behavior based or outcome based (Ouchi, 1979; Eisenhardt, 1985). The effects of these alternative control strategies were compared on the quality of user-developed applications. User-developers subjected to higher levels of behavior based control produced applications with superior documentation, testing, and backup provisions, but reported less satisfaction with the development process and the degree of self-determination. This research extends the Alavi, Phillips, and Freedman experiment in a field setting. Forty applications recently completed by non-MIS professionals in Houston area organizations were sampled. Questionnaires were completed by both the developers and users of the applications to assess the degree of control imposed over the development process, the developers reactions to the control environment, and the level of user satisfaction with: (1) the information provided by the application, (2) the thoroughness of testing, and (3) the documentation. Dissert. Abstr.

N90-17505# Office of Technology Assessment, Washington, DC.
FEDERAL SCIENTIFIC AND TECHNICAL INFORMATION IN AN ELECTRONIC AGE: OPPORTUNITIES AND CHALLENGES
Oct. 1989 42 p
(PB90-114414) Avail: NTIS HC A03/MF A01 CSCL 05B

The Federal Government is the largest single source of scientific and technical information (STI) in the world. Scientific advancement and technological innovation depend on the open exchange of STI. The House Committee on Science, Space and Technology asked the Office of Technology Assessment (OTA) to examine the opportunities and challenges facing the Federal Government with respect to the dissemination of STI. The staff paper presents the results of OTA's inquiry. OTA found that the government does not have an overall strategy on dissemination of STI. An overall strategy would help: (1) maximize the return on the substantial federal research and development investment; and (2) meet other national goals to which STI can contribute - such as improving the education of U.S. scientists and engineers, the international competitiveness of U.S. industry, and the strength of the U.S. civilian technology base. The paper answers questions within a framework for an overall strategy on STI dissemination, and identifies key elements that could be useful in such a strategy. A follow up OTA report (Spring 1990) will analyze selected strategic elements in greater depth. GRA

N90-17506# Naval Postgraduate School, Monterey, CA. Dept. of Computer Science.
THE REAL-TIME ROLL-BACK AND RECOVERY OF TRANSACTIONS IN DATABASE SYSTEMS M.S. Thesis
David E. Quantock Jun. 1989 103 p
(AD-A214471) Avail: NTIS HC A06/MF A01 CSCL 12/7

A modern database transaction may involve a long series of updates, deletions, and insertions of data and a complex mix of these primary catabase operations. Due to its length and complexity, the transaction requires back-up and recovery procedures. The back-up procedure allows the user to either commit or abort a lengthy and complex transaction without comprising the integrity of the data. The recovery procedure allows the system to maintain the data integrity during the execution of a transaction, should the transaction be interrupted by the system. With both the back-up and recovery procedures, the modern database system will be able to provide consistent data throughout the life-span of a database without ever corrupting either its data values or its data types. However, the implementation of back-up and recovery procedures in a database system is a difficult and involved effort since it effects the base as well as meta data of the database. Further, it effects the state of the database system. This thesis is mainly focused on the design trade-offs and issues of implementing an effective and efficient mechanism for back-up and recovery in the multimodel, multilingual, and multi backend database system. GRA

N90-17507# Naval Postgraduate School, Monterey, CA. Dept. of Administrative Sciences.
VALIDITY OF EMPIRICAL STUDIES OF INFORMATION SYSTEM EFFECTIVENESS M.S. Thesis
M. Agus Mustofa Jun. 1989 178 p
(AD-A214474) Avail: NTIS HC A09/MF A01 CSCL 12/7

This thesis reviewed 45 studies that purported to empirically assess the effectiveness of information systems. They were evaluated for: (1) vulnerability to alternative explanations of reported findings, (2) effect of data collection methods upon their conclusions, (3) capacity to establish causal inference, (4) how they defined system success and (5) reported changes in organizations following information system implementation. MIS research methods do not provide a basis for establishing causal inference. This, in turn, denies the possibility of constructing a formal theory to describe, explain or predict the successful implementation of information systems. This deficiency is worsened by the emergence of antagonistic schools of thought among MIS researchers as to how system effectiveness should be evaluated. Recommendations are made for improvements in MIS research designs and data collection techniques. Suggestions are made for ways by which line managers and commanders as well as managers of MIS activities must become informed consumers of MIS academic research on system effectiveness. GRA

N90-17508# BBN Systems and Technologies Corp., Cambridge, MA.
THE CRONUS DISTRIBUTED DBMS (DATABASE MANAGEMENT SYSTEM) PROJECT Final Report, Dec. 1986 - Dec. 1988
Richard Floyd, Sunil Sarin, and Stephen Vinter Oct. 1989 36 p
(Contract F30602-86-C-0271; AF Proj. 2530)
(AD-A214478; BBN-6973; RADC-TR-89-166) Avail: NTIS HC A03/MF A01 CSCL 12/7

Cronus is a distributed computing environment used to build and operate distributed applications. The distributed DBMS project has two main activities. The purpose of the Database Integration activity is to integrate a commercial, off-the-shelf database management system (DBMS) into Cronus, thereby making it available to any application using Cronus. The purpose of the Distributed DBMS activity is to conduct research into methods of infusing distributed database technology into Cronus. This report discusses the results of all work conducted under these activities. GRA

N90-17509# Maryland Univ., College Park. Dept. of Computer Science.
METHODOLOGY FOR DEVELOPING REALTIME DISTRIBUTED SYSTEMS Final Technical Report
Ashok K. Agrawala, Satish Tripathi, Udaya Shankar, Pankaj Jalote, and Scott Carson 1988 3 p
(Contract N00014-87-K-0241)
(AD-A214570) Avail: NTIS HC A01/MF A01 CSCL 12/7

The goal of this effort was to develop a methodology for establishing properties of realtime distributed operating systems. The major issues addressed include approaches to time and calendar management, verifiable kernel for meeting realtime constraints for aperiodic as well as periodic tasks, and distributed resource management schemes. The starting point in this effort was a complete evaluation and assessment of the current technology for realtime systems. This assessment was undertaken from theoretical as well as practical considerations. Our approach was to design an object based distributed system in which time properties of each object are explicitly represented and supported. The design was to be assessed through theoretical evaluation followed by a prototype implementation. GRA

N90-17510# Army Construction Engineering Research Lab., Champaign, IL.
GRASS/GIS (GEOGRAPHIC RESOURCES ANALYSIS SUPPORT SYSTEM/GEOGRAPHIC INFORMATION SYSTEM) IMPLEMENTATION GUIDE Final Report
Mary V. Martin, William D. Goran, Robert C. Lozar, Jean M. Messersmith, Marilyn S. Ruiz, and James D. Westervelt Oct. 1989 70 p
(AD-A214623; CERL-SR-N-90/02) Avail: NTIS HC A04/MF A01 CSCL 12/7

The GRASS/GIS Implementation Guide is a manual for the implementation and use of the Geographic Resources Analysis Support System (GRASS). GRASS is a microcomputer based image processing and geographic information system (GIS) used to develop, manipulate, analyze, and display geographic datasets. This Implementation Guide identifies procedures and issues relevant to user sites preparing to receive and implement GRASS software. Special attention is given to GRASS software capabilities, supported data types, hardware selection and configuration, and staff selection and training. Also included is a list of support structures and current publications relating to GRASS. GRA

N90-17511# Army Engineer Waterways Experiment Station, Vicksburg, MS. Geotechnical Lab.
A GEOGRAPHIC INFORMATION SYSTEM (GIS) FOR THE SOUTHERN LOUISIANA DELTAIC ENVIRONMENTS Final Report
A. N. Williamson and L. D. Britsch Oct. 1989 26 p Presented at the Annual Convention of the American Society for Photogrammetry and Remote Sensing and the American Congress on Surveying and Mapping, 2-7 Apr. 1989
(AD-A214676; WES/MP/GL-89-25) Avail: NTIS HC A03/MF A01 CSCL 08/6

Concern for the coastal zone throughout the United States has prompted implementation of geographic information systems (GIS) that can store the vast amounts of information on the infrastructure of these delicate environments, access and use the stored data to analyze changes that are occurring, and portray the results of analyses in the form of tables and/or maps and map overlays. A specific GIS of interest to the U.S. Army Engineer Waterways Experiment Station has been one that can be used to analyze land-loss conditions within the deltaic environments of Southern Louisiana. This GIS will allow Zenith, Model 248, or equivalent, microcomputers to be used to portray depletion in terms of the time period over which it has been occurring, where it has occurred, and the rate at which it is, or has been, occurring. This paper discusses some of the basic decisions that were made prior to implementing the GIS, the structure of the GIS, and some capabilities provided by the GIS using the stored data. GRA

N90-17512# SRI International Corp., Menlo Park, CA. DDN Network Information Center.
INTERNET PROTOCOL HANDBOOK. VOLUME 4: THE DOMAIN NAME SYSTEM (DNS) HANDBOOK
Jose Garcia-Luna, ed., Mary K. Stahl, ed., and Carol Ward, ed. Aug. 1989 208 p
(AD-A214698; NIC-50007-Vol-4) Avail: NTIS HC A10/MF A02 CSCL 12/7

The Internet Protocol Handbook explains the Domain Name System (DNS) and the Internet Host Table. This is volume 4 of the DDN PROTOCOL HANDBOOK four volume set. The first three volumes are a collection of documents on attaching computers to the DDN (Defense Data Network) using the DoD (Department of Defense) protocol suite. Volume 4 is divided into 2 sections. The first section covers the concepts and philosophy of the DNS as discussed in various articles and RFCs (Request for Comments). The second section focuses on the transition from the Internet Host Table to the DNS. Detailed information on DNS protocol standards and implementations are provided as are guidelines for the establishment and operation of domain name servers. The handbook concludes with a glossary of DNS acronyms. GRA

N90-17513# Naval Postgraduate School, Monterey, CA.
DATABASE CREATION AND/OR REORGANIZATION OVER MULTIPLE DATABASE BACKENDS M.S. Thesis
Deborah A. McGhee Jun. 1989 102 p
(AD-A214939) Avail: NTIS HC A06/MF A01 CSCL 12/7

To create a record in a database, one uses the INSERT command. However, in the Multi-Backend Database System (MBDS), the insert command only inserts one record at a time. When creating very large databases consisting of thousands or millions of records, the use of the INSERT command is a time-consuming process. Once a database is created, some of the records of the database may be tagged for deletion. MBDS uses the DELETE command to tag these records. Over some period of time, those records tagged for deletion should be physically removed from the database. Hence, removing tagged records is in essence creating new databases from untagged records. A methodology is presented in this thesis to efficiently create very large databases in gigabytes on parallel computers and to reorganize them when they have been tagged for deletion. Specifically, a utility program is designed to by-pass the system's INSERT command, to load the data of the database directly onto disks and create all the necessary base data and meta data of the database. GRA

N90-17514# Logistics Management Inst., Bethesda, MD.
AUTOMATED INFORMATION SYSTEMS PLAN Final Report
Dennis J. OConnor Oct. 1989 42 p
(Contract MDA903-85-C-0139)
(AD-A214982; LMI-DP701R1) Avail: NTIS HC A03/MF A01 CSCL 15/5

This plan contains a systematic approach for allocating automated data processing resources to support the functional and management activities of the OASD(P and L) staff. The plan is presented in six sections, one corresponding to each major P and L objective: Connectivity and data exchange with external systems and organizations; User support and enhanced operations; Cooperative OSD efforts; Hardware/software selection and procurement; Development and conversion of applications; and System security and integrity. GRA

N90-17515# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
DESIGN AND IMPLEMENTATION OF THE NESTED RELATIONAL DATA MODEL UNDER THE EXODUS EXTENSIBLE DATABASE SYSTEM M.S. Thesis
Michael A. Mankus Dec. 1989 65 p
(AD-A215356; AD-F000150; AFIT/GCS/ENG/89D-11) Avail: NTIS HC A04/MF A01 CSCL 12/5

The design and implementation of the nested relational data model is investigated. The data model is designed within the Exodus extensible architecture. Although a large amount of theory exists

with the model, no vehicle has been available to implement the concepts. The objective of the model is to increase performance of non-traditional databases by modeling real world objects in the problem domain into nested relations within the software domain of Exodus. Exodus is used to implement several components essential to the data model. First, the concept of nested relations is realized, and then a parser is developed to create and maintain a data dictionary. The Colby relational algebra is used to form the query tree for the query optimizer, and a plan tree permits the code to be generated for the query. Operator methods are developed for the query to be subsequently executed. The nested relational data model was implemented using the Exodus architecture. The nested relational data model was implemented using the Exodus architecture. The query tree was built and the code generated for the architecture's compiler. Operator methods were implemented for the project, select, and natural join operators. Because the data model can be implemented, more non-traditional databases can be developed with efficient components. GRA

N90-17516# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
DEFINITION OF A MANAGEMENT INFORMATION SYSTEM TO SUPPORT PERFORMANCE RISK ASSESSMENT M.S. Thesis
Paul W. Thurston, Jr. Sep. 1989 201 p
(AD-A215464; AFIT/GSM/LSR/89S-43) Avail: NTIS HC A10/MF A02 CSCL 05/1

Air Force Systems Command has recently put forth two major initiatives for improving the performance evaluation process to support source selection decisions: the Contractor Performance Assessment Reporting System (CPARS), a system for recording and distributing contractor performance information; and the Performance Risk Assessment Group (PRAG), a panel of seasoned acquisition experts chosen for each source selection to provide a performance risk assessment for each proposing contractor. CPARS exists as identical sets of contract assessment reports located at each of the product divisions. The files are updated as new reports are mailed by the originating agency to each of the other product divisions. Data request to support the PRAG are responded to with copies of the existing assessment reports. There is no automated capability to extract, reduce, or transform the CPARS data into information which can be readily used by the PRAG. The purpose of this thesis was to determine if a management information system based on the CPARS could be developed to support the performance assessment process. A tailored approach to the traditional method for software systems development was chosen to design an automated system to support performance risk assessment. This approach included steps for problem definition, requirements analysis, and development design. GRA

N90-17517# Lawrence Livermore National Lab., CA.
FINE TUNING YOUR SEARCH OUTPUT: WORD PROCESSORS, DESKTOP PUBLISHING, ELECTRONIC MAIL, DATABASES, AND BEYOND
Dana C. Ellingen Nov. 1989 5 p Presented at the Online 1989 Conference and Expostion, Chicago, IL, 7-9 Nov. 1989 Submitted for publication
(Contract W-7405-eng-48)
(DE90-005192; UCRL-102221; CONF-8911154-1) Avail: NTIS HC A02/MF A01

This paper presents an overview of possibilities and procedures for the delivery of the results of an online search. Word processors can add headers and footers which explain the topic of the search, even highlight search terms. Desktop publishing programs can produce typeset-like output. Electronic mail permits almost immediate delivery of search results. Local databases can give your patron results that can be searched time and again (provided you have taken care of copyright restrictions), give you a means for producing printed indexes of searches. Beyond lie personal information managers, hard disk organizers, and other new products. DOE

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

N90-17518# Army Aviation Systems Command, Saint Louis, MO.
IMPROPER USE OF ECONOMIC ANALYSIS IN MATERIEL COST COMPARISON STUDIES
Bernard J. Bauer, Jr. Sep. 1989 10 p Presented at the 23rd DOD Cost and Analysis Symposium, Leesburg, VA, 6-8 Sep. 1989
(AD-A214888) Avail: NTIS HC A02/MF A01 CSCL 05/3

Economic Analysis is defined in Army Regulation 11-28 as a systematic approach to the problem of choosing how best to employ scarce resources. This approach is an investigation of the full implications of achieving a given objective in the most effective manner. Economic analysis is utilized to examine various alternatives to solve a problem so that the decision maker can select the best option. Cost and benefits for each alternative are analyzed and compared. When employed properly, economic analysis is a powerful tool for the decision maker. When not prepared properly, the EA can lead to the wrong decision. The cost-benefit analysis is the basis for reviewing the various alternatives. This analysis enables the decision maker to examine the costs, weigh the benefits and to determine the feasibility of implementing each alternative. All options which are not viable are eliminated from further consideration. Those which survive the initial test of feasibility are compared to each other showing both costs and benefits. GRA

N90-16795# Leslie and Godwin Aviation Ltd., London (England).
LAUNCH INSURANCE: ITS ROLE IN THE FUTURE DEVELOPMENT OF COMMERCE IN SPACE
Antony A. M. Pinsent *In* ESA, Progress in Space Transportation Aug. 1989 p 99-107 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

N90-16796# Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.).
LEGAL ASPECTS OF COMMERCIAL SPACE TRANSPORTATION
Stephan F. vonWelck *In* ESA, Progress in Space Transportation Aug. 1989 p 109-11 (For primary document see N90-16782 09-16)
Copyright Avail: NTIS HC A22/MF A03

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N90-17519# Naval Postgraduate School, Monterey, CA.
COCOM (COORDINATING COMMITTEE FOR MULTILATERAL EXPORTS), TECHNOLOGY TRANSFER AND ITS IMPACT ON NATIONAL SECURITY M.S. Thesis
Warren E. Rhoades, III Jun. 1989 154 p
(AD-A214569) Avail: NTIS HC A08/MF A01 CSCL 05/1

This thesis looks at six key members of the Paris-based, Coordinating Committee for Multilateral Exports (COCOM), as well as the Soviet methods of acquiring Western technology. The Soviet acquisition of Western technology is a pressing concern for the Western world and will continue to grow. In analyzing the shortcomings of COCOM and the policy making process in West Germany, Great Britain, United States, France, Italy, and Japan, various propositions are identified which explain the flow of technology moving east. Critical variables include: the informal nature of COCOM itself, each country's commercial orientation, the lack of national security input when conducting export transactions, the specific country's political will and technological proficiency, the amount of trade the specific country does with the Soviet bloc in conjunction with their export process, laws and sanctions against violators, as well as their participation within COCOM. Policy remedies based on the research are suggested. GRA

88 SPACE SCIENCES (GENERAL)

N90-17520# Consiglio Nazionale delle Ricerche, Frascati (Italy). Ist. di Fisica dello Spazio Interplanetario.
[ACTIVITIES REPORT OF THE INSTITUTE OF INTERPLANETARY STELLAR PHYSICS] Annual Report, 1988 [RAPPORTO DI ATTIVITA 1988]
Apr. 1989 37 p In ITALIAN
(IFSI-89-8; ETN-90-96170) Avail: NTIS HC A03/MF A01

The current research projects are summarized. The research is grouped into four main directions: infrared astronomy, interplanetary media, cosmic rays and gravitational fields. ESA

N90-17521# Consiglio Nazionale delle Ricerche, Frascati (Italy). Ist. di Fisica dello Spazio Interplanetario.
REPORT ON SCIENTIFIC ACTIVITY AND FUNDS MANAGEMENT FOR 1988 Progress Report, 1988 [RENDICONTO SULL'ATTIVITA SCIENTIFICA E RENDICONTO ANALITICO SULL'IMPIEGO DEI FONDI NELL'ANNO 1988]
Apr. 1989 121 p In ITALIAN
(IFSI-89-9; ETN-90-96171) Avail: NTIS HC A06/MF A01

The current research projects are summarized. The projects are grouped into four main directions: infrared astronomy, interplanetary media, cosmic rays and gravitational fields. The projects include instruments for the infrared space observatory satellite and problems of star formation and star evolution. The tethered satellite system experiment, Opera experiment, propagation of cosmic rays in the ionosphere, design of a solar neutron detector, and gravitational wave antennas experiments are discussed. ESA

89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

N90-17522# Pacific Northwest Lab., Richland, WA.
STABLE AURORAL RED ARC OCCURRENCES DETECTED BY THE PACIFIC NORTHWEST LABORATORY PHOTOMETER NETWORK: A DECADE OF OBSERVATIONS, 1978 - 1988
D. W. Slater and E. W. Kleckner Nov. 1989 20 p
(Contract DE-AC06-76RL-01830)
(DE90-004994; PNL-7184) Avail: NTIS HC A03/MF A01

Using data obtained from a network of all-sky scanning photometers designed to operate routinely for long periods of time, a comprehensive inspection of observations covering the time period 1978 to 1988 has revealed features that were interpreted to be Stable Auroral Red (SAR) arcs during 250 nighttime observing periods. These arcs result from high temperature within the ionospheric electron gas that is maintained by slow leakage of energy from the earth's magnetosphere. A listing of these events, the most complete available for this time interval, is presented for the purpose of complementing observations reported for earlier dates. This listing is composed of location of the observing photometer, date, time, photometric intensity, and location (as defined by the earth's magnetic coordinate system). The intent is to make these observations available to a broad range of researchers and thereby initiate further investigations of these features. DOE

N90-17523# Naval Observatory, Washington, DC.
PROCEEDINGS OF COLLOQUIUM 110 OF THE INTERNATIONAL ASTRONOMICAL UNION ON LIBRARY AND INFORMATION SERVICES IN ASTRONOMY
George A. Wilkins and Sarah Stevens-Rayburn 1989 259 p
Coll. held in Washington, D.C., 26 Jul. - 1 Aug. 1988
(AD-A215612) Avail: NTIS HC A12/MF A01 CSCL 05/2

This report provides an overview of the presentations and summaries of discussions at IAU Colloquium 110, which was held in Washington, D.C., on 26-30 July 1988 and at the Goddard Space Flight Center on 1 August 1988. The topics included: the publication and acquisition of books and journals; searching for astronomical information; the handling and use of special-format materials; conservation; archiving of unpublished documents; uses of computers in libraries; astronomical databases and various aspects of the administration of astronomy libraries and services. Particular attention was paid to new developments, but the problems of astronomers and institutions in developing countries were also considered. GRA

90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics*.

N90-17524 Harvard Univ., Cambridge, MA.
VARIATIONAL PROBLEMS IN ASTROPHYSICS Ph.D. Thesis
William Alan Jeffrey 1988 195 p
Avail: Univ. Microfilms Order No. DA8908982

Three distinct astrophysical problems that are solved variationally are presented. The first problem establishes the solar radial differential rotation in the outer third of the convection zone. Included is a means for determining the random component of the noise from the data itself, a new procedure for performing the inversion, and a method for using this knowledge in ascertaining the statistical significance of the result. Simulations are employed to illustrate the procedure. Applying this approach to existing data, researchers conclude that the sun's equatorial rotation rate decreases between 10 and 30 Mm below the temperature minimum. The implications of this finding to our understanding of solar structure are examined. The second problem exploits line profile data to ascertain the rotational structure of astronomical objects. Analyzed in detail are radio observations of ammonia line inversions for studying protostar formation in dense molecular cloud cores. A new method for solving this problem is presented, along with simulations that demonstrate the power of this technique. The final problem applies variational techniques to finding the stable states of dynamical systems. Rather than explicity integrating the equations of motion, which dictate the relaxational time scale, researchers opt to minimize a Lyapunov functional which characterizes the physical system. Dissert. Abstr.

N90-17525*# Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
A CURRENT DISRUPTION MECHANISM IN THE NEUTRAL SHEET FOR TRIGGERING SUBSTORM EXPANSIONS Final Report
A. T. Y. Lui, A. Mankofsky, C.-L. Chang, K. Papadopoulos, and C. S. Wu (Maryland Univ., College Park.) Dec. 1989 23 p
Revised Submitted for publication
(Grants NAG5-759; NAGw-971)

(NASA-CR-186260; NAS 1.26:186260) Avail: NTIS HC A03/MF A01 CSCL 03B

Two main areas were addressed in support of an effort to understand mechanism responsible for the broadband electrostatic noise (BEN) observed in the magnetotail. The first area concerns the generation of BEN in the boundary layer region of the magnetotail whereas the second area concerns the occassional presence of BEN in the neutral sheet region. For the generation of BEN in the boundary layer region, a hybrid simulation code was developed to perform reliable longtime, quiet, highly resolved simulations of field aligned electron and ion beam flow. The result of the simulation shows that broadband emissions cannot be generated by beam-plasma instability if realistic values of the ion beam parameters are used. The waves generated from beam-plasma instability are highly discrete and are of high frequencies. For the plasma sheet boundary layer condition, the wave frequencies are in the kHz range, which is incompatible with the observation that the peak power in BEN occur in the 10's of Hz range. It was found that the BEN characteristics are more consistent with lower hybrid drift instability. For the occasional presence of BEN in the neutral sheet region, a linear analysis of the kinetic cross-field streaming instability appropriate to the neutral sheet condition just prior to onset of substorm expansion was performed. By solving numerically the dispersion relation, it was found that the instability has a growth time comparable to the onset time scale of substorm onset. The excited waves have a mixed polarization in the lower hybrid frequency range. The imposed drift driving the instability corresponds to unmagnetized ions undergoing current sheet acceleration in the presence of a cross-tail electric field. The required electric field strength is in the 10 mV/m range which is well within the observed electric field values detected in the neutral sheet during substorms. This finding can potentially account for the disruption of cross-tail current and its diversion to the ionosphere to form the substorm current wedge. Furthermore, a number of features associated with substorm expansion onset can be understood based on this substorm onset scenario.

Author

N90-17526*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

GUIDE TO THE US COLLECTION OF ANTARCTIC METEORITES 1976-1988 (EVERYTHING YOU WANTED TO KNOW ABOUT THE METEORITE COLLECTION). ANTARCTIC METEORITE NEWSLETTER, VOLUME 13, NUMBER 1

Roberta Score and Marilyn M. Lindstrom Feb. 1990 137 p
(NASA-TM-101939; JSC-24158; NAS 1.15:101939; SSED-PSB-82) Avail: NTIS HC A07/MF A01 CSCL 03B

The state of the collection of Antarctic Meteorites is summarized. This guide is intended to assist investigators plan their meteorite research and select and request samples. Useful information is presented for all classified meteorites from 1976 to 1988 collections, as of Sept. 1989. The meteorite collection has grown over 13 years to include 4264 samples of which 2754 have been classified. Most of the unclassified meteorites are ordinary chondrites because the collections have been culled for specimens of special petrologic type. The guide consists of two large classification tables. They are preceded by a list of sample locations and important notes to make the tables understandable.

E.R.

N90-17527# Catholic Univ. of America, Washington, DC. Dept. of Mechanical Engineering.

MHD (MAGNETOHYDRODYNAMIC) SLOW SHOCKS IN CORONAL AND INTERPLANETARY SPACE Final Report, 1 Jun. 1986 - 31 May 1989

Yun C. Whang Aug. 1989 34 p
(Grant AF-AFOSR-0160-86; AF Proj. 2311)
(AD-A214725; AFOSR-89-1350TR) Avail: NTIS HC A03/MF A01 CSCL 03/2

Shock waves of the solar terrestrial medium in coronal and interplanetary space was studied. The understanding on the propagation of large amplitude disturbances from the solar corona through the interplanetary space is enhanced. Work accomplished during the past three years includes: (1) a demonstrating example showing the formation of slow shock pairs associated with Coronal Mass Ejections (CMEs) in a coronal environment; (2) a parametric study of slow shocks in the entire domain of a 3-D parameter space, the A, theta, beta-space; (3) the large scale geometry of traveling interplanetary shocks; (4) the transition of slow shocks to fast shocks in the inner solar wind; and (5) the evolution of CME associated shocks and their interplanetary manifestations.

GRA

N90-17528# Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics.

COSMOLOGICAL OBSERVATIONS IN AN INHOMOGENEOUS UNIVERSE

Kazuya Watanabe and Kenji Tomita Jun. 1989 30 p
(DE90-733096; RRK-89-19) Avail: NTIS (US Sales Only) HC A03/MF A01

The distance-redshift relation in an inhomogeneous universe is studied. On the basis of relativistic optical equations, numerical calculations are performed to get a realistic distance-redshift relation. It is shown that the distance-redshift relation is coincident with that in the standard Friedmann-Robertson-Walker (FRW) model on average if galaxies or clusters of galaxies are assumed to be completely transparent. Researchers also show that the effect of shear along the light path is small if the scale of inhomogeneities is larger than galactic scale and that numerical results are consistent with the analytical investigation recently done by Futamase and Sasaki.

DOE

N90-17529# Fermi National Accelerator Lab., Batavia, IL.

THE AGE OF THE UNIVERSE: CONCORDANCE

David N. Schramm Dec. 1989 18 p Presented at the 5th IAP Astrophysics Meeting on Astrophysical Ages and Dating Methods, Paris, France, 26-29 Jun. 1989
(Contract DE-AC02-76CH-03000; NSF AST-88-22595; NAGw-1321)
(DE90-004971; FNAL/C-89-253A; CONF-8906206-4) Avail: NTIS HC A03/MF A01

Arguments on the Age of the Universe, t sub u, are reviewed. The four independent age determination techniques are: dynamics (Hubble Age and deceleration); oldest stars (globular clusters); radioactive dating (nucleocosmochronology); and white dwarf cooling (age of the disk). While discussing all four, this review will concentrate more on nucleocosmochronology due in part to recent possible controversies there. It is shown that all four techniques are in general agreement, which is an independent argument in support of a catastrophic creation event such as the Big Bang. It is shown that the most consistent range of cosmological ages is for 12 (approx. less than) t sub u (approx. less than) 17Gyr. It is argued that the upper bound from white dwarf cooling is only (approximately) 10 Gyr due to the disk of the Galaxy probably forming several Gyr after the Big Bang itself. Only values of the Hubble constant, H sub 0 (approx less than) 60km/sec/Mpc, are consistent with the other age arguments if the universe is at its critical density. An interesting exception to this limit is noted for the case of a domain wall dominated universe where ages as large as 2/H sub 0 are possible.

DOE

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

No abstracts in this category.

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

For related information see *93 Space Radiation.*

N90-17530# Argonne National Lab., IL.
BOREX: SOLAR NEUTRINO EXPERIMENT VIA WEAK NEUTRAL AND CHARGED CURRENTS IN BORON-11
T. Kovacs, J. W. Mitchell, P. Raghavan, R. S. Raghavan, S. J. Freedman, J. Kay, C. E. Lane, R. I. Steinberg, C. Cattadori, and A. Donati (Laboratori Nazionali del Gran Sasso, Assergi, Italy) et al 1989 6 p Presented at the International Conference: Inside the Sun, Versailles, France, 22-26 May 1989 Prepared in cooperation with MIT, Cambridge, MA; Milan Univ., Italy; Hawaii Univ., Manoa and Pavia Univ., Italy
(Contract W-31-109-eng-38)
(DE90-003790; CONF-890520-4) Avail: NTIS HC A02

Borex, an experiment to observe solar neutrinos using boron loaded liquid scintillation techniques, is being developed for operation at the Gran Sasso underground laboratory. It aims to observe the spectrum of electron type B-8 solar neutrinos via charged current inverse beta-decay of B-11 and the total flux solar neutrinos regardless of flavor by excitation of B-11 via the weak neutral current. DOE

N90-17531# Sandia National Labs., Albuquerque, NM. Solar Thermal Test Facility.
MULTI-DIMENSIONAL DISCRETE ORDINATES SOLUTIONS TO COMBINED MODE RADIATION HEAT TRANSFER PROBLEMS AND THEIR APPLICATION TO A FREE-FALLING PARTICLE, DIRECT ABSORPTION SOLAR RECEIVER Ph.D. Thesis - New Mexico State Univ.
Michael J. Rightley Nov. 1989 265 p
(Contract DE-AC04-76DP-00789)
(DE90-004987; SAND-89-2294) Avail: NTIS HC A12/MF A02

Multi-dimensional radiative transfer in combined mode heat transfer problems was investigated with emphasis on the analysis and characterization of a free-falling particle cloud, direct absorption solar central receiver. A model was developed to calculate the relevant distributions in the curtain while a concentrated solar beam is impinging on the front face of the medium. The discrete ordinated approximation was applied to allow the spectral equation of transfer (EOT) to be modeled as a PDE. Model verification tests were conducted to determine the accuracy of the model. One- and two-dimensional results showed that the discrete ordinates model provides satisfactory estimates of the radiant intensity, the heat flux and the temperature distributions for ordinate sets above S(sub 4) (12-flux approximation) for both the black and gray cases. DOE

N90-17532# Aerospace Corp., El Segundo, CA. Space Sciences Lab.
SOLAR CYCLE EFFECTS ON TRAPPED ENERGETIC PARTICLES
Alfred L. Vampola 15 Oct. 1989 47 p
(Contract F04701-88-C-0089)
(AD-A215028; TR-0089(4940-05)-3; SD-TR-89-78) Avail: NTIS HC A03/MF A01 CSCL 22/1

The energetic particle populations in the earth's magnetosphere, which are the result of geomagnetic activity and, ultimately, are due to solar activity, have a major impact on the operation and survival of spacecraft. Departures from the nominal in solar activity produce requirements for changes from the nominal in the design and operation of spacecraft. If the approaching solar maximum is a robust one, as is indicated by preliminary solar data, the approaching solar maximum is a robust one, as is indicated by preliminary solar data, the energetic particle population can be expected to be in excess of that predicted by particle models such as AE8 and AP8, since those models include solar cycle effects based on nominal solar activity. In the event of a robust solar cycle, accelerated degradation of electronics and power systems, increased sensor background effects, and more frequent operational anomalies may be expected on spacecraft which were designed for a nominal energetic particle population that could be expected based on a robust solar Cycle 22. GRA

N90-17533# National Academy of Sciences - National Research Council, Washington, DC. Committee on Solar Physics.
FIELD OF SOLAR PHYSICS: REVIEW AND RECOMMENDATIONS FOR GROUND-BASED SOLAR RESEARCH Final Report
14 Sep. 1989 70 p
(Grant NSF AST-87-04262)
(PB90-115684; ISBN-0-309-04082-5; LC-89-62832) Avail: NTIS HC A04/MF A01 CSCL 03B

The present vitality, quality, and directions of solar research is presented. Included is a determination of the present and future needs for goundbased observational facilities and instrumentation, and for related analysis and theory, in terms of the priority needs of the solar community. Broad institutional issues are identified and possible institutional changes are recommended to help overcome problems. The survey covers the science opportunities in the field of solar physics; the demographic composition and view of solar physicists; requirements for instrumentation, observations, theory, analysis, and data availability; and identifies a number of critical problem areas, prominent among which is that the university role in solar physics is inadequate to sustain a vital science. Author

N90-17534# Max-Planck-Inst. fuer Kernphysik, Heidelberg (Germany, F.R.).
THE GALLEX PROJECT
1989 13 p Presented at the International Conference: Inside the Sun, Versailles (France), 22-26 May 1989 Prepared in cooperation with Kernforschungszentrum, G.m.b.H., Karlsruhe; Milan Univ.; Technische Univ, Munich; Nice Univ., France; Rome Univ., Italy; Commissariat a l'Energique Atomique, Gif-sur-Yvette; Weizmann Inst. of Science, Rehovot and BNL, NY
(Contract DE-AC02-76CH-00016)
(DE90-005573; BNL-43669; CONF-890520-5) Avail: NTIS HC A03/MF A01

The GALLEX collaboration aims at the detection of solar neutrinos in a radiochemical experiment employing 30 tons of Gallium in the form of concentrated aqueous Gallium-chloride solution. The detector is primarily sensitive to the otherwise inaccessible pp-neutrinos. Details of the experiment have been repeatedly described before. Here we report the present status of implementation in the Laboratori Nazionali del Gran Sasso (Italy). So far, 12.2 tons of Gallium are at hand. The present status of development allows for the start of the first full scale run at the time when 30 tons of Gallium become available. This date is expected to be January, 1990. DOE

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

N90-17535*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ESTIMATES OF GALACTIC COSMIC RAY SHIELDING REQUIREMENTS DURING SOLAR MINIMUM
Lawrence W. Townsend, John E. Nealy, John W. Wilson, and Lisa C. Simonsen Washington Feb. 1990 15 p
(NASA-TM-4167; L-16715; NAS 1.15:4167) Avail: NTIS HC A03/MF A01

Estimates of radiation risk from galactic cosmic rays are presented for manned interplanetary missions. The calculations use the Naval Research Laboratory cosmic ray spectrum model as input into the Langley Research Center galactic cosmic ray transport code. This transport code, which transports both heavy

ions and nucleons, can be used with any number of layers of target material, consisting of up to five different arbitrary constituents per layer. Calculated galactic cosmic ray fluxes, dose and dose equivalents behind various thicknesses of aluminum, water and liquid hydrogen shielding are presented for the solar minimum period. Estimates of risk to the skin and the blood-forming organs (BFO) are made using 0-cm and 5-cm depth dose/dose equivalent values, respectively, for water. These results indicate that at least 3.5 g/sq cm (3.5 cm) of water, or 6.5 g/sq cm (2.4 cm) of aluminum, or 1.0 g/sq cm (14 cm) of liquid hydrogen shielding is required to reduce the annual exposure below the currently recommended BFO limit of 0.5 Sv. Because of large uncertainties in fragmentation parameters and the input cosmic ray spectrum, these exposure estimates may be uncertain by as much as a factor of 2 or more. The effects of these potential exposure uncertainties or shield thickness requirements are analyzed. Author

N90-17536# Lawrence Livermore National Lab., CA.
THERMAL PAIR CLOUD MODELS OF MeV GAMMA RAY EMISSIONS FROM CYGNUS X-1 AND THE GALACTIC CENTER
E. P. Liang and C. D. Dermer 12 Sep. 1989 4 p Presented at the 21st International Cosmic Ray Conference, Adalaide, Australia, 6-19 Jan. 1990
(DE90-001168; UCRL-101948; CONF-900122-4) Avail: NTIS HC A01/MF A01

The HEAO-3 data for the enhanced MeV gamma ray emissions of Cygnus X-1 and the Galactic Center in 1979 can be modeled by thermal emissions from a compact pair dominated cloud surrounding the black hole. The structure of such pair clouds are derived from first principles and these results are used to constrain the mass of the central black hole, the viscosity parameter and other parameters of the innermost accretion flow. The production and escape of pairs are estimated outside the thermal cloud due to collisions of gamma rays with other gamma rays and with x rays from the disk. The annihilation of such escaped pairs in the cool medium far from the source can lead to detectable narrow 511 keV lines. These results are compared with the variable 511 keV source in the Galactic Center and the upper limits for Cygnus X-1. Author

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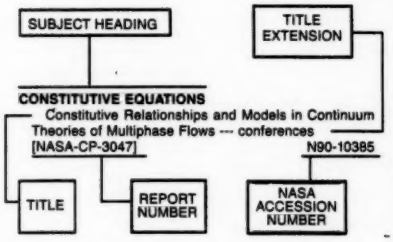

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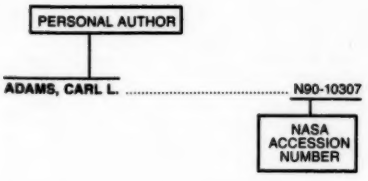

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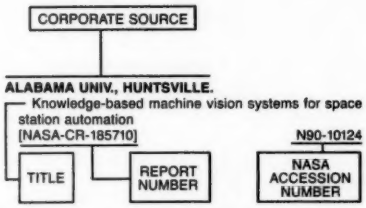

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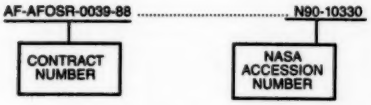

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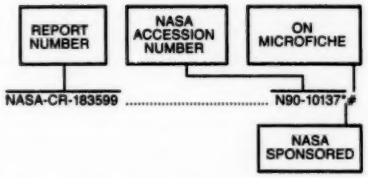

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Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

For related information see also *Astronautics.*

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Davis Library 080A
BA/SS Department Documents
Chapel Hill, NC 27514
(919) 962-1151

NORTH DAKOTA

NORTH DAKOTA STATE UNIVERSITY LIBRARY
Government Documents Dept.
Fargo, ND 58105
(701) 237-8352
In cooperation with Univ. of North Dakota, Chester Fritz Library
Grand Forks

OHIO

STATE LIBRARY OF OHIO
Documents Section
65 South Front Street
Columbus, OH 43266
(614) 644-7051

OKLAHOMA

OKLAHOMA DEPT. OF LIBRARIES
Government Documents
200 NE 18th Street
Oklahoma City, OK 73105
(405) 521-2502, ext. 252

OKLAHOMA STATE UNIV. LIB.
Documents Department
Stillwater, OK 74078
(405) 624-0489

OREGON

PORTLAND STATE UNIV.
Millar Library
934 SW Harrison - P.O. Box 1151
Portland, OR 97207
(503) 229-3673

PENNSYLVANIA

STATE LIBRARY OF PENN.
Government Publications Section
Box 1601
Walnut St. & Commonwealth Ave.
Harrisburg, PA 17105
(717) 787-3752

SOUTH CAROLINA

CLEMSON UNIV. COOPER LIB.
Documents Department
Clemson, SC 29634
(803) 656-5174
In cooperation with Univ. of South Carolina, Thomas Cooper Library, Columbia

TEXAS

TEXAS STATE LIBRARY
Public Services Department
P.O. Box 12927 - 1201 Brazos
Austin, TX 78711
(512) 463-5455

TEXAS TECH. UNIV. LIBRARY
Documents Department
Lubbock, TX 79409
(806) 742-2268

UTAH

UTAH STATE UNIVERSITY
Merrill Library & Learning Resources Center, UMC-30
Documents Department
Logan, UT 84322
(801) 750-2682

VIRGINIA

UNIVERSITY OF VIRGINIA
Alderman Library
Government Documents
Charlottesville, VA 22903
(804) 924-3133

WASHINGTON

WASHINGTON STATE LIBRARY
Document Section
Olympia, WA 98504
(206) 753-4027

WEST VIRGINIA

WEST VIRGINIA UNIV. LIB.
Government Documents Section
P.O. Box 6069
Morgantown, WV 26506
(304) 293-3640

WISCONSIN

ST. HIST SOC. OF WISCONSIN LIB.
Government Pub. Section
816 State Street
Madison, WI 53706
(608) 262-2781
In cooperation with Univ. of Wisconsin-Madison, Memorial Library

MILWAUKEE PUBLIC LIBRARY
Documents Division
814 West Wisconsin Avenue
Milwaukee, WI 53233
(414) 278-3065

WYOMING

WYOMING STATE LIBRARY
Supreme Court & Library Bldg.
Cheyenne, WY 82002
(307) 777-5919

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